the OIL AND GAS JOURNAL
PUBLISHED WEEKLY March 21, 1960

Nation's reserves climb to new highs ▸ 71

New play hits old Matagorda County ▸ 78

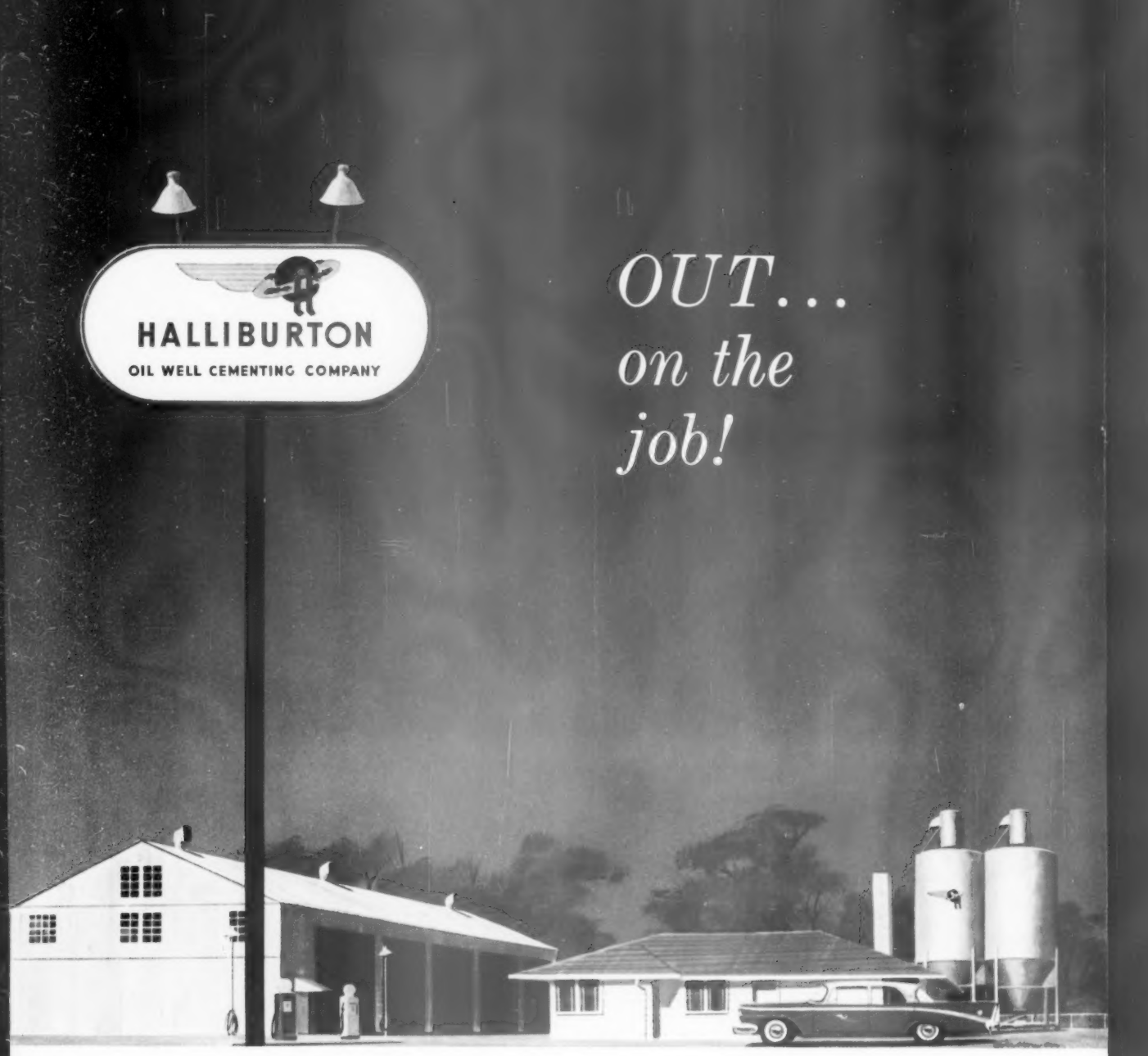
Proration threatens Texas' stripper floods ▸ 100

Beginning: Quiz on refining operations ▸ 116

MEXICAN OIL

Where Pemex stands today—22 years after expropriation. It's a towering bureau with a budget of 8 billion pesos—almost equal to that of the entire national government.

p. 90



OUT... on the job!

Everybody's out except the vitally important Radio Dispatcher who makes possible continuous coordination between Engineers, Cementers, and equipment wherever in the district they happen to be on a customer's job.

Halliburton maintains the most complete job coordinating facilities in the oil patch . . . 24 hours a day the camp is in constant touch with your requirements, ready to move men and equipment to the point where you may need it.

Call us first *for Service and we'll be there.*

HALLIBURTON OIL WELL CEMENTING COMPANY

DUNCAN, OKLAHOMA

OIL AND GAS JOURNAL
Vol. 58, No. 12

Contents March 21, 1960

THE WEEK'S NEWS

General Interest:

U. S. Reserves Hit New High in Spite of Record Production ... 71
Supervisors Are Cutting Costs for The California Co. ... 75
Texas Again Probes Puzzle of Excessive Stocks ... 76
Court Rules for Sinclair in Wyoming School Tax Case ... 79
Import Exchanges Follow No Set Pattern ... 80
Oil Industry May Drop Opposition to Revised Fuels-Study Plan ... 86
New Federal Leasing Bill Making Progress in Congress ... 86
Pan Am Wyoming Lease Case Stymied by Legal Technicality ... 87
Arguments Cited in Debate on U.S. Tanker Proposal ... 89

Pipelining:

New $25 Million Gas Line Will Serve Texas Power Plants ... 82
Pipeline Briefs ... 84
Panhandle Eastern Plans Expansion in Midwest ... 85
Pipeliners Work on Better Ways to Figure Weighting Costs ... 88
Two Companies Formed to Move Gas to TGT ... 88
Southern Oklahoma Gas Price Cut 5 Cents ... 89

Drilling-Production:

Texas Cuts Allowable to 9 Days for April ... 77
API Committee Seeking Fishing Guide ... 84
New Chemical Prevents Paraffin Build-up ... 85

Foreign News:

Booming Pemex Is Expanding in All Divisions ... 90
More U. S. Firms Win Concessions in Spanish Sahara ... 93
San Jacinto Denies Below-Market Sales in Venezuela ... 94
Pemex Chief Says South American Trip Misinterpreted ... 94
Line From Big Field in India to Be Ready in 1961. ... 94

Processing:

Esso Drops Refinery-Mechanic Classification at Baton Rouge ... 74
Processing Briefs ... 82

Exploration:

Newest Kenai Well Is Best Yet in Alaska ... 74
Old Texas Oil Area Is Making Drilling News Again ... 78
Shell Wildcat May Be Discovery for Remote Texas Area ... 87
Northern Missouri Production Leads to New Interest in Area ... 159
South Dakota Calls for More and Deeper Drilling ... 160

EVERY WEEK

Advertisers' Index ... 201
Calendar of Events ... 60
Classified Advertising ... 197
Deaths ... 190
Discovery Wells ... 184
Drilling Contractors ... 153
Drilling Statistics ... 193
Editorial ... 67
Equipment Men ... 148
Exploration Highlights ... 159
Foreign News ... 90
Foreman's Page ... 115
Journally Speaking ... 65
Markets ... 196
New Equipment ... 135
On the Job—Pipelining ... 129
Personals ... 187
Production ... 194
Refining Statistics ... 195
Statistical Summary ... 192
The Journal Said ... 65
They Say ... 56
Trade Literature ... 145
Watching Washington ... 79

Technology-Operation section on next page →

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TECHNOLOGY—OPERATION

Production

Texas Water-Flood Curtailment Could Destroy Incentive 100

By George H. Edgerton

Proration of water-flood production to normal yardstick level would reduce the state's total output by only 1.5%. The price of this small percentage might well be the drastic curtailment of stripper flood development in Texas. The author feels that some distinction must be made between stripper water floods and pressure-maintenance projects.

Drilling

What Our Turbodrilling Tests Taught Us 103

By W. E. Bingman

Turbodrilling cannot, as yet, compete economically with good rotary practices. Where effective bit weight cannot be used with rotary, turbodrilling should eventually prove competitive. Both rock bits and diamond bits will require modification for turbodrilling. Turbodrills, too, need modification before turbodrilling can be used effectively.

Pipelining

Pipeliners Answer Corrosion Questions 129

By Gene Kinney

Members of an NACE panel composed of experts on various phases of corrosion mitigation, answered pipeliners' questions during a 3-day short course in Tulsa. Here is a report on the more significant questions and answers.

Processing

Automatic Control with High-Speed Chromatography 96

By M. M. Fourroux, F. W. Karasek, and R. E. Wightman

A new high-speed chromatographic analyzer, designed specifically for process control, has operated successfully in commercial closed-loop control systems. The analyzer has improved control substantially on a natural-gas-liquids depropanizer and also on a furfural absorber.

Putting Linear Programing to Work 108

By John E. Chenevey

Part 2 of three parts. Here is an example which shows linear-programing-solution technique in detail. Is is solved using ordinary algebra; thus, each step can be followed easily. Part 1 of the series (March 7), illustrated problem formulation and solution in general terms.

Refining

The Foreman's Page 115

How pipe size, roughness, and fittings affect pumping of gas and liquids. Part 3 of the current series on fluid flow.

WPRA Refining Quiz on Catalytic Reforming 116

Here is the transcript of the question-and-answer session on catalytic reforming held at a regional meeting of the Western Petroleum Refiners Association in El Dorado, Ark. These down-to-earth questions and answers get right to the heart of the day-to-day operating problems encountered in catalytic reforming.

Process Costimating—68 127

Data on use of TEL in U. S. gasolines 1926-1959.

the OIL AND GAS JOURNAL Newsletter

Tulsa, Okla.
March 21, 1960

Exploration men still are making news.

Texas, for instance, has two significant strikes at:

...Shell and Cities Service 1 Allsup in Cass County in a sparsely explored spot of northeastern Texas. Well is 20 miles from production. It flowed at rate of 3,900 M.c.f. of gas daily through 20/64-in. choke from Smackover formation at 10,297 ft. Gas yielded 200 bbl. daily of condensate.

...Shell's 1 LaCasse in western Bandera County. It has such a promising show of gas and oil it seems a sure producer. Well brings oil to a little explored island province right in the middle of the vast Edwards Plateau (p. 87).*

Intensive wildcat drilling continues unabated in Texas' Matagorda County which has had oil since the turn of the century. Discoveries and field extensions spark wave of drilling.

There are 29 active drilling operations. Ten of these are wildcats and the rest actually are extensions or tests in new areas of fields (p. 78).

▼ ▼ ▼

Down the road:

Look for drilling activity to hum in the Rockies when the weather improves.

Observers there report first-quarter activity is about even with last year. Bad weather, however, has built up a large backlog of activity to come when spring finally arrives.

Recent Niobrara discovery in eastern San Juan basin of New Mexico by Intex Oil may set off shallow play. It would match the early day activity of Verde-Horseshoe Canyon on the west side of the basin.

Seven locations are already staked or active in the area now. Intex and Kern County Land both are active.

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*Refers to article in this issue giving more details. Where no page is given, the item is a Newsletter exclusive.

Discovery of oil in Missouri—something of a rarity—points up possibilities that await the independent operator in the Forest City basin (p. 159).

The basin is a sparsely explored region of 15,000 sq. miles in four states and offers prospects down to 4,000 ft. The recent strike, the 1 Currie of William Gruenerwald, Chicago geologist, was completed for 125 bbl. daily from the Viola-Ordovician at 2,967-72 ft.

▼ ▼ ▼

Canadian drillers are going great guns.

Well completions are up 20% over first 2 months of last year. Contractors have been busier than in any winter for 5 years.

Statistics show: 458 wells completed in the four western provinces and Northwest Territories. That is 76 wells more than were drilled in the same period last year. Saskatchewan is the only region showing a decline in drilling.

Over-all success record: 70% of all wells drilled to completion have been either oil or gas producers. The wildcats have been 25% successful.

Tidewater plans immediate exploration in Spanish Sahara.

As operator of a joint venture with Ohio Standard, Tidewater already is making logistics study of its eight tracts covering about 5 million acres. This is preparatory to imminent geologic evaluation.

Operations will center at Las Palmas in the Canary Islands, 120 miles off the Sahara coast. The two companies also have an exploration license in southwestern Spain proper near Seville.

▼ ▼ ▼

Good news in Alaska: Success of the 1 Soldatna wildcat of California Standard and Richfield makes the Kenai region even more attractive. The wildcat tested 1,879 bbl. daily through a half-inch choke. It was drilled on a 72,000-acre unit south of the Swanson River unit which boasts six producing wells.

The Paul G. Benedum group has denied rumored oil showings at the 1 Nulato Unit in Alaska's Koyukuk basin. Well is drilling ahead below 6,725 ft. It's being closely watched because of its effect on a wide area of holdings.

▼ ▼ ▼

Oil men made best showing in 8 years last year in adding to the nation's petroleum reserves (p. 71).

The country now holds peak reserves in crude, natural-gas liquids, and natural gas in spite of increased production last year.

Most of the added reserves came from extensions to known fields or pools and revisions of past reserve estimates.

▼ ▼ ▼

How much weight coating is needed to keep marine pipelines from floating is research task of pipeline division of American Society of Civil Engineers.

Answer to the question could save millions yearly. It becomes more important as pipelines are laid to an increasing extent in the Gulf of Mexico, coastal marshes, and across lakes and rivers (p. 88).

More pipeline plans are afoot in Libya.

Oasis Oil Co., operator for the three company group of Ohio, Continental, Amerada, is trying to decide the most practical plan for moving its production to the coast.

There is a well-founded speculation that Oasis may join with Esso in a joint building scheme. At least the two may build common terminal facilities on the Mediterranean.

New company called Natural Gas Gathering Co., Inc., has been formed to buy and gather gas in South Texas.

The project, reportedly backed by Delhi Taylor, would operate to deliver gas to interstate pipelines. The first customer is expected to be Tennessee Gas (p. 88).

Important gas case has been won by Kansas Corporation Commission. A district court upheld the agency's right to consider interstate supply and demand factors in setting the Kansas gas allowables.

The commission contended that the Hugoton field is entitled to share proportionately with other sources in supplying pipeline company markets.

Verdict on gas exports is expected from Canada's National Emergency board before the month is out.

Trade Minister Gordon Churchill denies decision has been made but promises ruling in next few days. Several firms, including Trans-Canada Pipe Lines, Alberta & Southern Gas., and Westcoast Transmission have applications pending to move big chunks of gas into the U. S. market.

▼ ▼ ▼

Hopes for labor peace in Venezuela have been dealt a chilling blow despite new 3-year labor contract.

Large group of employes discharged before the new contract was signed demonstrated at Punto Fijo on the Paraguana Peninsula, demanding government help.

They want full benefits of the new contract from October 20, when the old contract expired, until the first week of

February, when they lost their jobs. New contract was signed 2 weeks after this.

Oil companies say most of the out-of-work men were discharged by contractors with curtailed work programs brought on by higher taxes and increased labor costs.

Breast beatings from Russia: Soviets have shaved U. S. oil production superiority from 11:1 in 1946 to 2.7:1 now and have actually outstripped U. S. in gas reserves. This from Foma Trebin, head of Soviet technical scientific committee.

▼ ▼ ▼

Other oil executives will be interested in approach of California Co. to cost cutting.

Economy campaign covers every phase of company activity from the cost of casing to pay of stenographers.

What makes it work is this: Responsibility for whacking costs is put squarely in lap of the line supervisor. The supervisors have achieved excellent results (p. 75).

New electronic data-processing system has been introduced by Bendix for high-speed scientific, business, and industrial use.

The G-20 is capable of 45,000 floating point operations per second. Its advantages, according to Bendix: Leasing for less than $10,000 per month; speed many times as fast as conventional computers; low operating costs.

Signs listing gasoline prices without taxes still adorn the curbs at many Virginia service stations even though their appearance failed to forestall a state tax increase.

The Virginia Legislature voted a 1-cent per gallon increase effective July 1, making the tax load 11 cents.

Even so, some service-station operators are keeping the signs. They feel the pricing practice will serve as a steady reminder to motorists of the high tax burden.

▼ ▼ ▼

The Washington oil beat:

...Proposed substitute version of fuels policy bill is termed decided improvement by API Chief Frank Porter. However, Porter considers the appointment of a special committee to study policy unnecessary. Data already is available and existing committees could do job (p. 86).

...Swaps of imported crude have been going like this: Domestic inland refiners have been getting an average 1.06 bbl. of high-priced American crude in exchange for each barrel of foreign crude in their quota. The daily averages have been 319,725 bbl. of domestic crude for 301,041 bbl. of foreign (p. 80).

Good Wells Make Good News

A Report on Recent Engineered Acid Treatments

March 21, 1960

Dowell engineers can now use more proved services, products and techniques than ever before to design effective acid treatments. Here are four recent treatments that used advanced engineering to good effect.

- **Spencer County, Indiana** (New Oil Well) This well made a show of oil upon completion into the Rosiclare. The pay is a dirty lime. Dowell recommended acidizing with 3000 gallons inhibited acid. Two Dowell addition agents were used to prevent emulsions and control silicate swelling. Injection rate was held to 1.5 bpm during treatment. 30 days after treatment well tested 95 bopd with no water — an unusually good well for the area.

- **Central Alberta, Canada** (New Oil Well) This well was completed in the Slave Point formation on the edge of a pool in the Swan Hills region. The pay is a fast-reacting limestone. There was no production and the operator considered abandonment. Dowell engineered a treatment using the "Acid Guide"*. The formation was washed 4 hours with 500 gallons Mud Acid. Then 500 gallons Retarded Acid was squeezed into the formation at one bpm and 3800 psi. After treatment, the well made field allowable and was put on production.

- **Eastland County, North Texas** (New Oil Well) This well went to water after conventional perforating and acidizing. The operator squeezed with Cealment*, latex-cementing service; then used Abrasijet*, abrasive-fluid jetting service, to re-perforate into the Marble Falls conglomerate from 2955 to 2968 feet. Next, 250 gallons Dowell acid were jetted into the formation through the tool used in Abrasijet. Before treatment, well produced 100 per cent water. After treatment, it produced 25 bopd with no water.

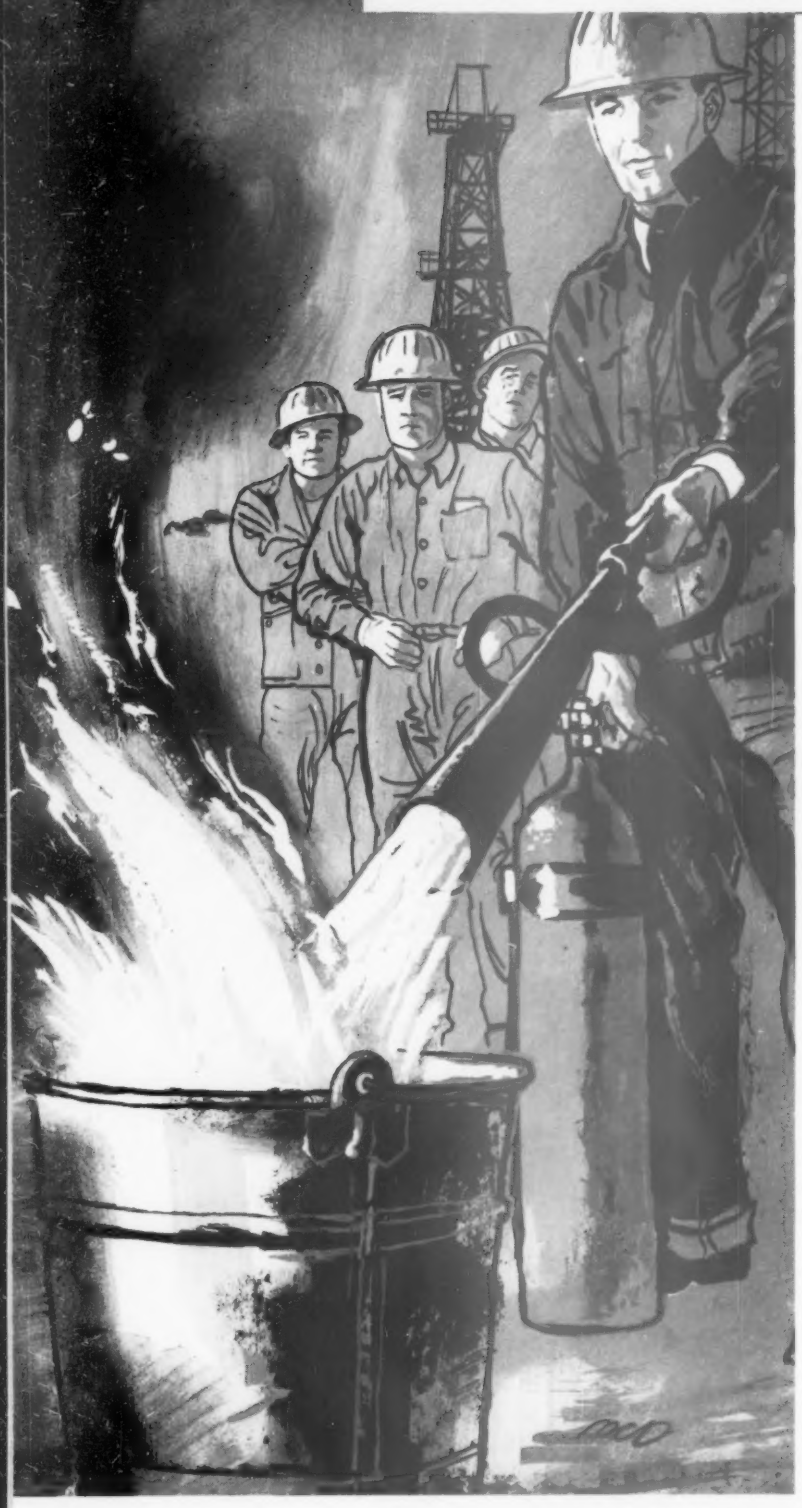
- **Lea County, New Mexico** (Old Oil Well) This well had depleted the McKee sand and was plugged back and re-completed in the Abo limestone from 7122 to 7226 feet. Core analysis showed iron compounds to be present. Dowell recommended Stabilized Acid to prevent the possible precipitation of gummy iron hydroxides. 6000 gallons Stabilized Acid were injected. Perforation ball sealers were used during treatment. Production increased from a show to 200 bopd (with no water) through a 20/64th-inch choke.

Engineered acidizing by Dowell helps you improve profits by getting maximum return from your acidizing dollar. For service or detailed information, contact the Dowell office or station nearest you. Dowell services and products are offered from more than 150 locations in the United States, Canada, Venezuela, and Argentina. Dowell, Tulsa 1, Oklahoma.

*DOWELL TRADEMARK

Services for the oil industry DOWELL
DIVISION OF THE DOW CHEMICAL COMPANY

How **protection in depth** helps cut compensation costs



Preparing your crew to fight their No. 1 enemy

A rig fire improperly handled and not immediately controlled often causes serious bodily injury. Sometimes death. Always it is damaging and costly. Liberty Mutual engineers attack this problem by making recommendations as to fire protection equipment, by helping you train your men to fight fires, and by going over your entire rig with a sharp eye for fire hazards. Fire safety engineering is but one of the many Liberty Mutual services that add up to protection in depth. To learn more about Liberty's protection in depth and how it can help lower your business insurance costs, get in touch with the Liberty Mutual office nearest you.

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Quick dissolving and free flowing, Du Pont improved flaked petroleum dyes take approximately half the space of the powdered form.

Free flowing Du Pont *flaked* dyes offer refineries important advantages

Du Pont offers oil colors either in powder or flaked form.

Since Du Pont flaked dyes are virtually dust free, they have been gaining steadily in popularity. And now the newest flaked dyes from Du Pont are further improved; they dissolve more readily than ever.

Less bulk. You'll find that the flaked Du Pont Petroleum Dyes take approximately half the space of the same dye in powdered form, thus saving valuable storage space. Flaked dyes are shipped in easily handled small drums.

Wide color range. You can get Du Pont flaked dyes in orange, red and bronze. Blue is supplied in a crystalline form offering approximately the same advantages as you get when you use Du Pont flaked dyes.

More information. For more details and samples, contact your Du Pont Petroleum Chemicals representative. Or write to: E. I. du Pont de Nemours & Company (Inc.), Petroleum Chemicals Division, Wilmington 98, Delaware.

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Better Things for Better Living
. . . through Chemistry

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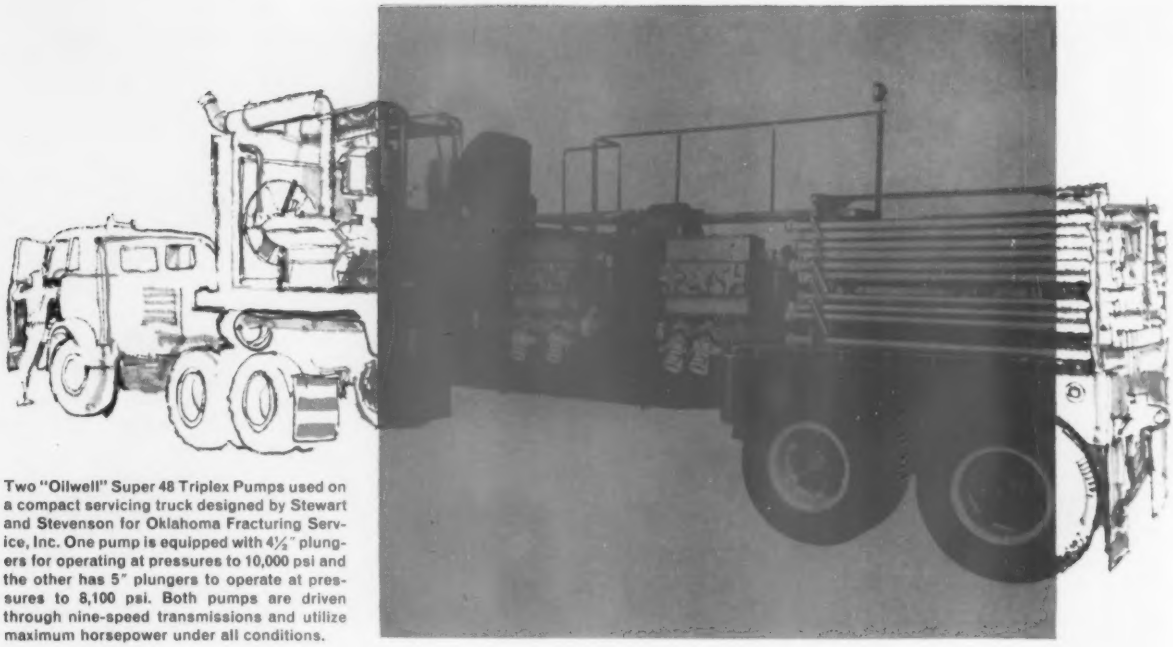
and other
Petroleum Additives



Two "Oilwell" Super 48 Triplex Pumps used on a compact servicing truck designed by Stewart and Stevenson for Oklahoma Fracturing Service, Inc. One pump is equipped with 4¼" plungers for operating at pressures to 10,000 psi and the other has 5" plungers to operate at pressures to 8,100 psi. Both pumps are driven through nine-speed transmissions and utilize maximum horsepower under all conditions.

"Oilwell's" SUPER 48—

the No. 1 pump for tough fracturing service . . .

Plenty of horsepower in a small package—that's what you get with the Super 48 triplex pump, designed for fracturing and acidizing units.

The pump is light in weight and is well within road-width limits when mounted crosswise on the truck. Its modern welded alloy-steel frame provides plenty of strength for the maximum working pressure of 10,000 psi. The fluid end is a one-piece alloy-steel forging which includes the valve chambers and discharge connections.

High quality construction throughout assures low operating costs and minimum maintenance. For further information on the Super 48, contact your nearest "Oilwell" store or sales office.

USS and "Oilwell" are registered trademarks

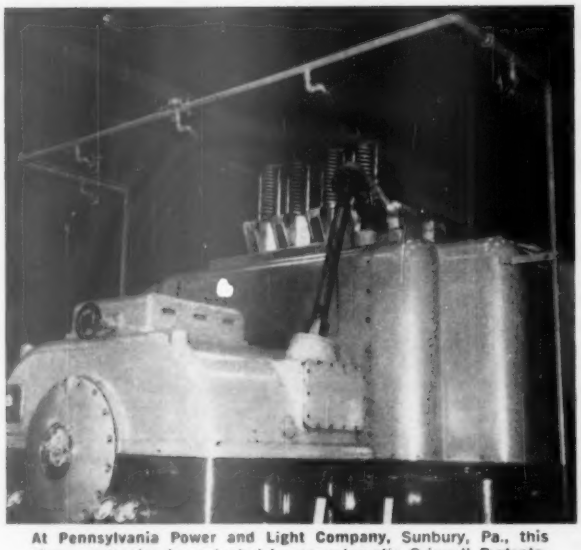
Look at this data!

Type	triplex, single acting
Capacity	to 930 gpm
Pressure	to 10,000 psi
Input BHP	to 700 (intermittent)
Weight	8,240 lbs. (pump without skids)
Dimensions	7'6" x 4' x 3'6"
Power Frame	enclosed one-piece alloy-steel weldment
Fluid End	forged alloy-steel with quick-opening hammer-lug valve and cylinder-head caps
Plungers	CO-HARD, with pressure lubrication
Valves and Seats	carburized, alloy-steel, wing-guided insert type

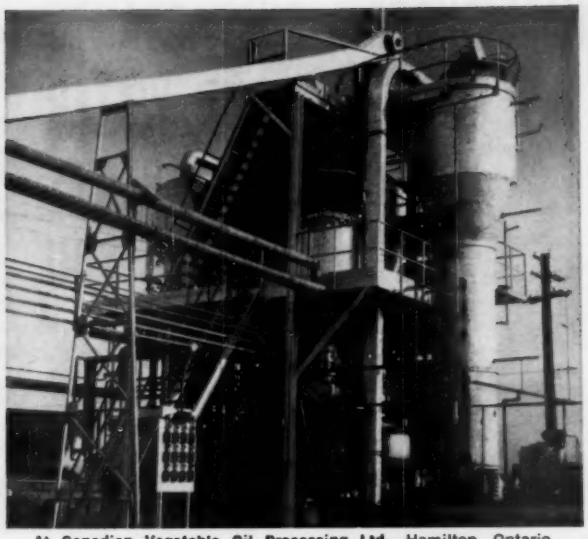
USS

Oil Well Supply Division of United States Steel

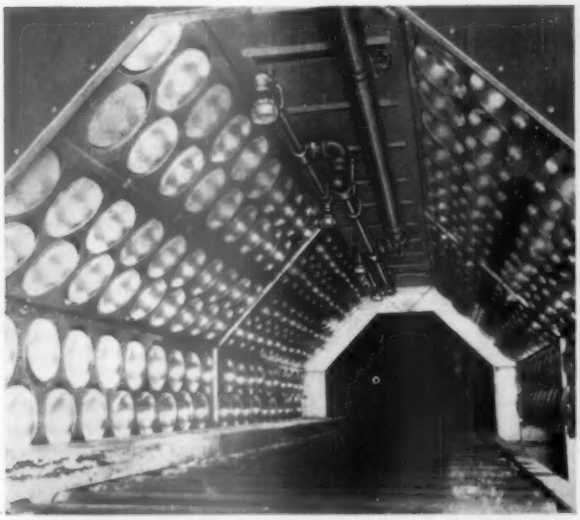
Executive Office—Dallas, Texas
Export Office—30 Rockefeller Plaza, New York 20, N.Y.



At **Pennsylvania Power and Light Company**, Sunbury, Pa., this steam generator is protected by an automatic Grinnell Protecto-Spray system in the event of outside fires and by a Dry Chemical system inside the casing.



At **Canadian Vegetable Oil Processing Ltd.**, Hamilton, Ontario, Grinnell ProtectoSpray safeguards upper structure of this hexane solvent extraction unit, while a ProtectoFoam system guards the lower section.



At the **RCAF supply depot at Namao, Alberta**, this infrared drying oven is protected by a Dry Chemical system engineered by Grinnell to protect against possible fire resulting from ignition of flammable vapor mixtures.

At **Dresser Industries, Inc.**, Dallas, Texas, hot metal temporarily ignites resulting vapors as metal is being submerged. If fire should get out of control, a Grinnell-installed Carbon Dioxide system is on guard to extinguish it quickly.

You can rely on Grinnell for the right protection against destruction by fire!

Grinnell has had 90 years experience in devising fire protection systems for all kinds of fire hazards — systems which can be relied on to protect the continuity of your business and to safeguard your dollar investment. Grinnell offers you quality-controlled manufacturing, layouts by experienced engineers, and installations by skilled crews. Let Grinnell engineers help you select the right system.

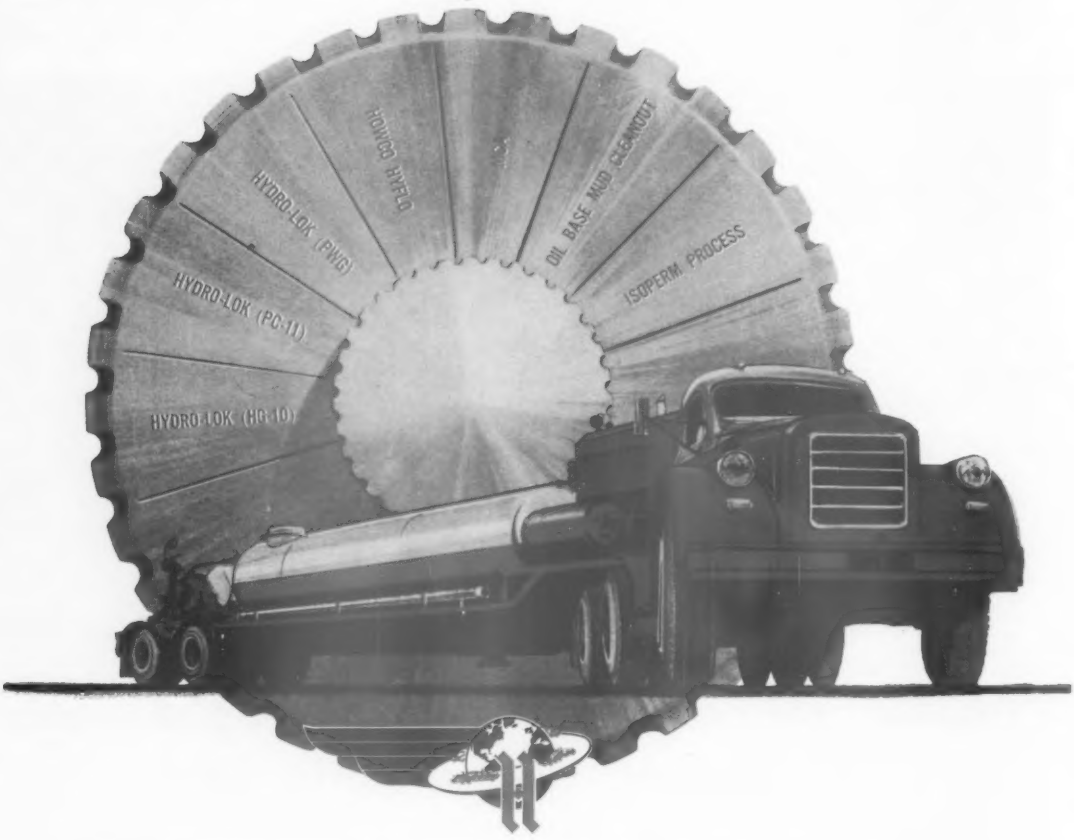
16 mm. Sound-Color Film—Get up to date on fire with Grinnell's 35-minute film — "Fire Protection Through Research." Both typical and unusual fire hazards are described and demonstrated. To borrow this film, without charge, write — Grinnell Company, Providence 1, Rhode Island.

GRINNELL

FIRE PROTECTION SYSTEMS SINCE 1870

HALLIBURTON SURFACTANTS AND WATER CONTROL AGENTS GIVE YOU

SELECTIVITY



Production stimulation problems are as many and as varied as the formations that cause them. To help you overcome many of these problems with the greatest effectiveness, Halliburton has developed an extensive group of production stimulants. Each is designed to accomplish a certain task *best* in your well to aid you in obtaining maximum production from each formation.

Development of production stimulants, water control agents and the creation of new and improved chemicals for the petroleum industry is a tradition at Halliburton . . . a tradition which will continue to point the way to more efficient servicing of your well . . . and possibly more profit for you.

SURFACTANTS

HOWCO HYFLO ●

A surfactant for use in oil designed to help break or prevent emulsions and water blocks. It is particularly effective in helping prevent emulsified obstructions in the formation flow channels resulting from oil base fracturing jobs.

Mud Cleanout Agent (MCA) ●

HCL plus Morflo II . . . a mixture designed to aid in restoring damaged permeability. It is particularly effective in shrinking and dispersing water sensitive clays . . . naturally occurring or deposited while drilling . . . also helps destroy water and emulsion blocks.

OIL-BASE MUD CLEANOUT ●

Since regular MCA is not effective on all oil-base and oil emulsion type mud cleanout problems, Halliburton has developed a surfactant-oil blend utilizing the excellent dispersing properties of DOC-3 . . . which can also be used on water base muds and for stuck drill pipe. A Howco Hyflo-oil mixture is also an oil base mud removal solution.

WATER CONTROL AGENTS

HYDRO-LOK (PWG) ●

PWG is a resin solution designed for helping shut off water bearing formations near the pay zone. Its extremely low viscosity aids in entering the true permeability of the formation before it sets. PWG setting time is very short, once setting begins. It forms a very stiff gel which will withstand considerable formation pressure, but is easy to drill out . . . also a proven pressure grouting chemical for helping control unwanted water in mining and construction operations.

HYDRO-LOK (PC-11) ●

PC-11 is a mixture of resins and inert solid materials which form a plastic slurry. It is very effective in controlling water in zones of high permeability, fractured sandstones and limestones. Also, the low viscosity of the resin in the slurry allows the treatment of low permeability formations.

HYDRO-LOK (HG-10) ●

This relatively low viscosity resin is recommended where deep penetration in the formation is necessary and a harder set than that obtained with PWG is desired. After setting, HG-10 is insoluble in all known solvents.

ISOPERM PROCESS ●

This chemical plugging agent is insoluble in most normal well fluids, but can be removed by a conventional acid treatment. The Isoperm Process is the injection of two chemical solutions that react in the formation. Their reaction forms a gelatinous presipitate which greatly reduces the formation's permeability, but does not plug it completely.

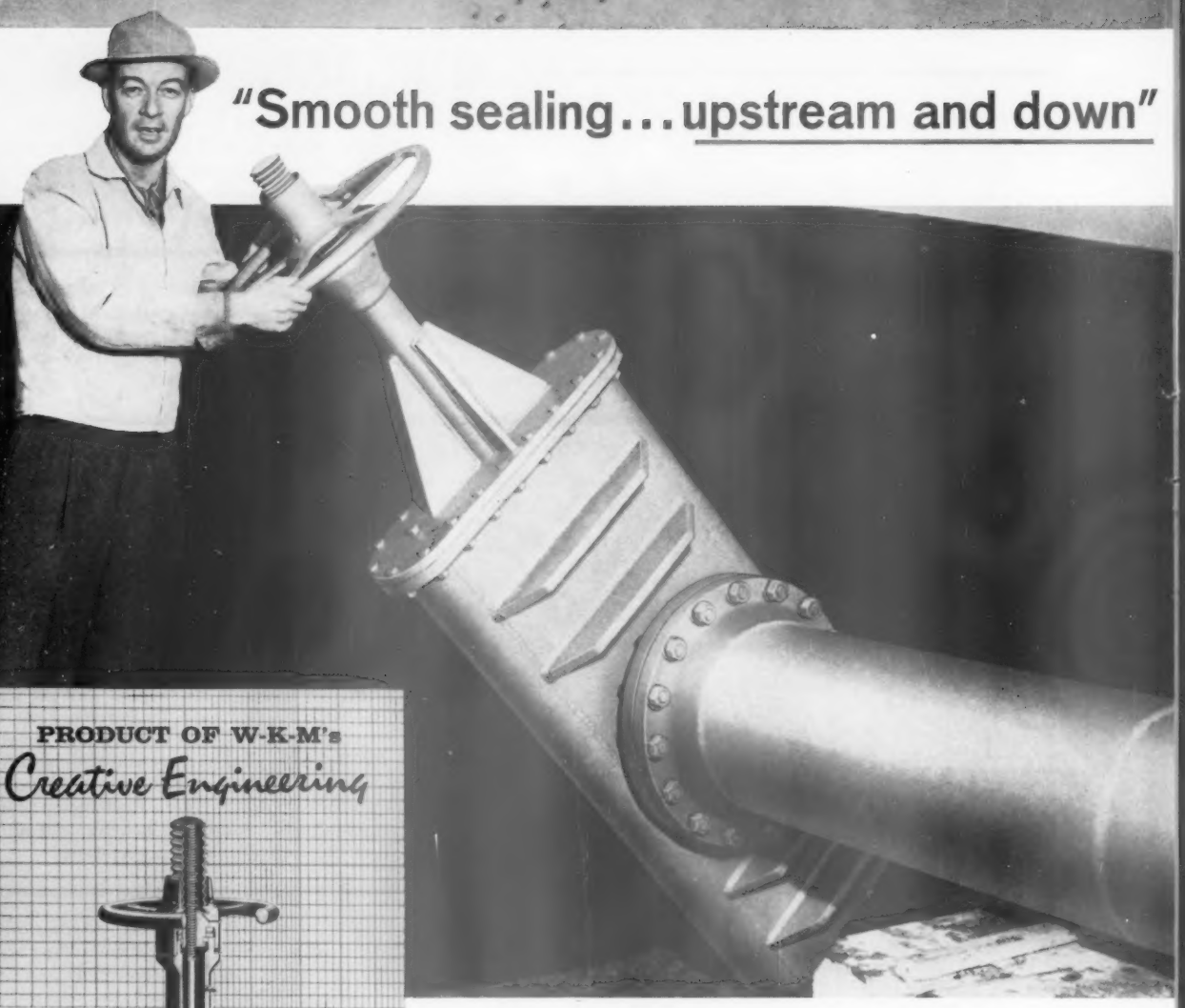
Check with your HALLIBURTON representative about these advanced products!

HALLIBURTON CHEMICAL SERVICES

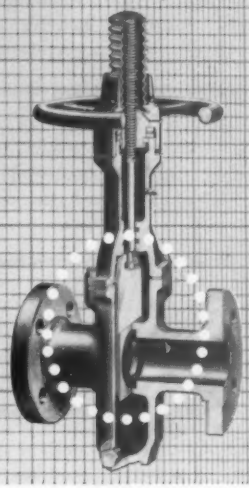
HALLIBURTON OIL WELL CEMENTING COMPANY — DUNCAN, OKLAHOMA

275 SERVICE CENTERS — JUST MINUTES AWAY FROM YOUR WELL

"Smooth sealing... upstream and down"



PRODUCT OF W-K-M's
Creative Engineering



FLOATING SEATS MAKE THE SEAL

Seats are specially formulated rubber molded to a hardened steel insert. They float against the gate. When the gate closes, line pressure forces the gate against the downstream seat making a tight seal. The upstream seat maintains its seal against the gate for an upstream seal. The valve provides a tight seal under little or even no line pressure or under vacuum conditions.

5925

W-K-M's new Pressure Sealing Gate Valve

Almost without effort . . . you get a tight seal on *both* sides of the line. The secret? A unique seat design that puts line pressure to work *for* you. The greater the pressure, the tighter the seal!

Seats automatically adjust for wear . . . automatically relieve excessive body pressure. And on-the-line overhaul is easy.

Specify W-K-M's economical new Pressure Sealing Gate Valve for pressures to 720 psi (cwp) and temperatures to 250° F. Sizes 2″ through 30″. *At leading supply stores everywhere.*

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Delivery is quick. Order THREDKOTE 701 from your nearest Humble bulk plant in Texas, New Mexico and Arizona. Other areas contact Humble Oil & Refining Company, Houston, Texas.

HUMBLE

HUMBLE OIL & REFINING COMPANY

You save drilling dollars with

THE

MUD PROBLEM: Overcome pressure differential sticking (wall sticking) of drill pipe and casing.

WELL DATA

Location: Lake Boeuf Field, Lafourche Parish, Louisiana
Total Depth: 13,685′

MUD ADDITIVE PROGRAM

0′ to 8,000′	Native mud plus AQUAGEL*, caustic soda and Q-BROXIN**
8000′ to 13,685′	Gyp—Q-BROXIN emulsion. TRIMULSO* and DMS† below 7″ liner depth

TYPICAL MUD PROPERTIES

Depth	12,000	12,800	13,315[1]	13,653[2]
Weight, ppg	15.8	16.1	16.1	18.1
Viscosity, sec. API	60	55	60	65
Plastic Viscosity, cp	50	48	52	71
Yield Point lb/100 sq ft	15	7	12	14
Filtrate, cc API	21.8	2.0	2.2	0.5
Calcium, ppm	840	1360	1600	720

[1]Before addition of TRIMULSO and DMS
[2]After addition of TRIMULSO and DMS

CASING PROGRAM

Size Inches O.D.	*Depth Set Feet*
13⅜	3,022
9⅝	10,997
7 (liner)	13,301
5 (liner)	13,685

*Registered trademark of Baroid Division National Lead Company
**Registered trademark of Puget Sound Pulp and Timber Company
†Registered trademark of Magnolia Petroleum Company

PROBLEM: To prevent differential sticking of drill pipe. Insure landing and cementing of liner at total depth.

DISCUSSION: High mud weights are required to contain abnormally high formation pressures in this field. The difference between the mud column pressure and the pressure in the porous zones may cause differential sticking of drill pipe and liners. Differential sticking is evidenced by: the tendency for drill pipe to stick while making connections, running directional surveys, etc.; full circulation of the mud is possible while the pipe is stuck; and there may be no previous history of tight hole.

SOLUTION: Pilot tests on mud samples and previous experience with comparable jobs indicated that TRIMULSO would alleviate this troublesome condition. TRIMULSO was added to this emulsion mud while the mud weight was being increased to 18 ppg.

This well was successfully drilled to its objective without any difficulty with stuck drill pipe, and the 5″ liner was easily run and cemented.

a Baroid Mud Program

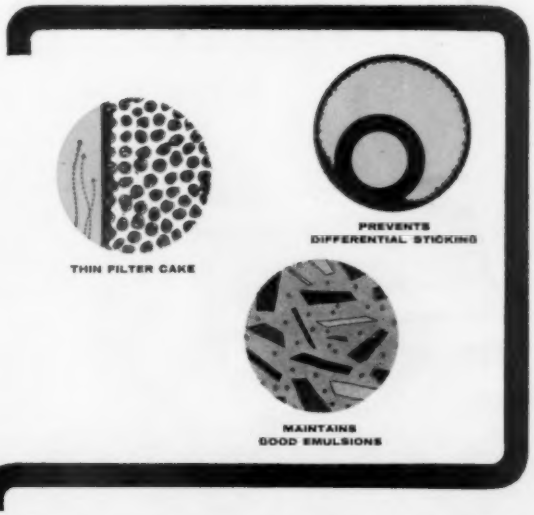
MUD PROBLEM

... and its solution

This case history shows again how a complete Baroid mud program helps accomplish your drilling objective. A costly fishing operation was prevented by the use of the specific product TRIMULSO.

Baroid's previous experience enabled the diagnosis of the potentially costly fishing job that would result from differential sticking. Previous experience also resulted in prevention of the trouble by the engineered use of TRIMULSO.

This is more proof that Baroid's new concept of modern marketing brings you added advantages. You get an *integrated service* that combines engineering skills developed in all drilling areas, quality-controlled products and complete delivery service that *saves your drilling dollars!*



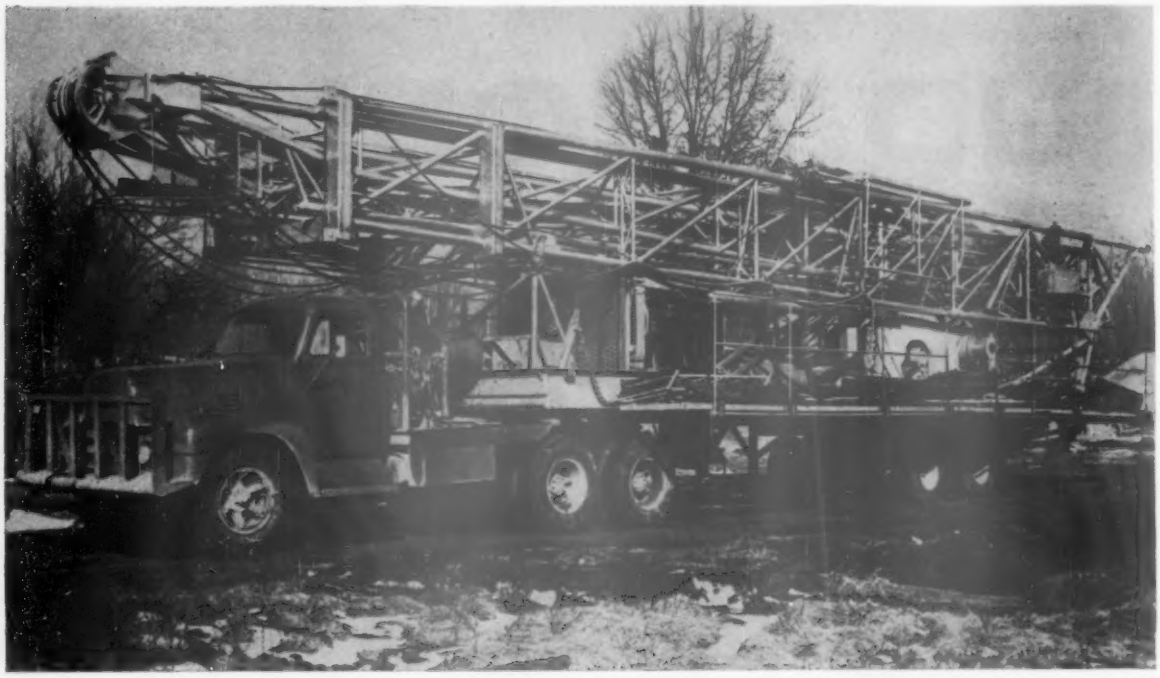
BAROID

BAROID DIVISION NATIONAL LEAD COMPANY

MAIN OFFICE: P. O. BOX 1675, HOUSTON 1, TEXAS

6042

Better products, *faster,* from your Bower Distributor:



Bower helps "shoulder" your load to keep rigs rolling

Bower tapered roller bearings, with special Spher-O-Honed rollers, run with less friction to move heavier loads faster

When your operation calls for portable rigs, Bower roller bearings do a better job in transporting big, heavy equipment. Bower long-life quality tapered bearings are made to give long, maintenance-free service for both standard and special equipment.

Bower Spher-O-Honed roller heads are spherically contour ground. They need no run-in. High flanges cut unit pressure—improve alignment. Oil grooves are bigger for positive roller lubrication. All these add up to keep friction and wear at a minimum.

For the finest in tapered or straight roller bearings, see your Bower Bearing Distributor. He gives fast delivery from a complete stock of both types.

BOWER ROLLER BEARINGS

FEDERAL-MOGUL SERVICE

DIVISION OF FEDERAL-MOGUL-BOWER BEARINGS, INC. • DETROIT 13, MICHIGAN

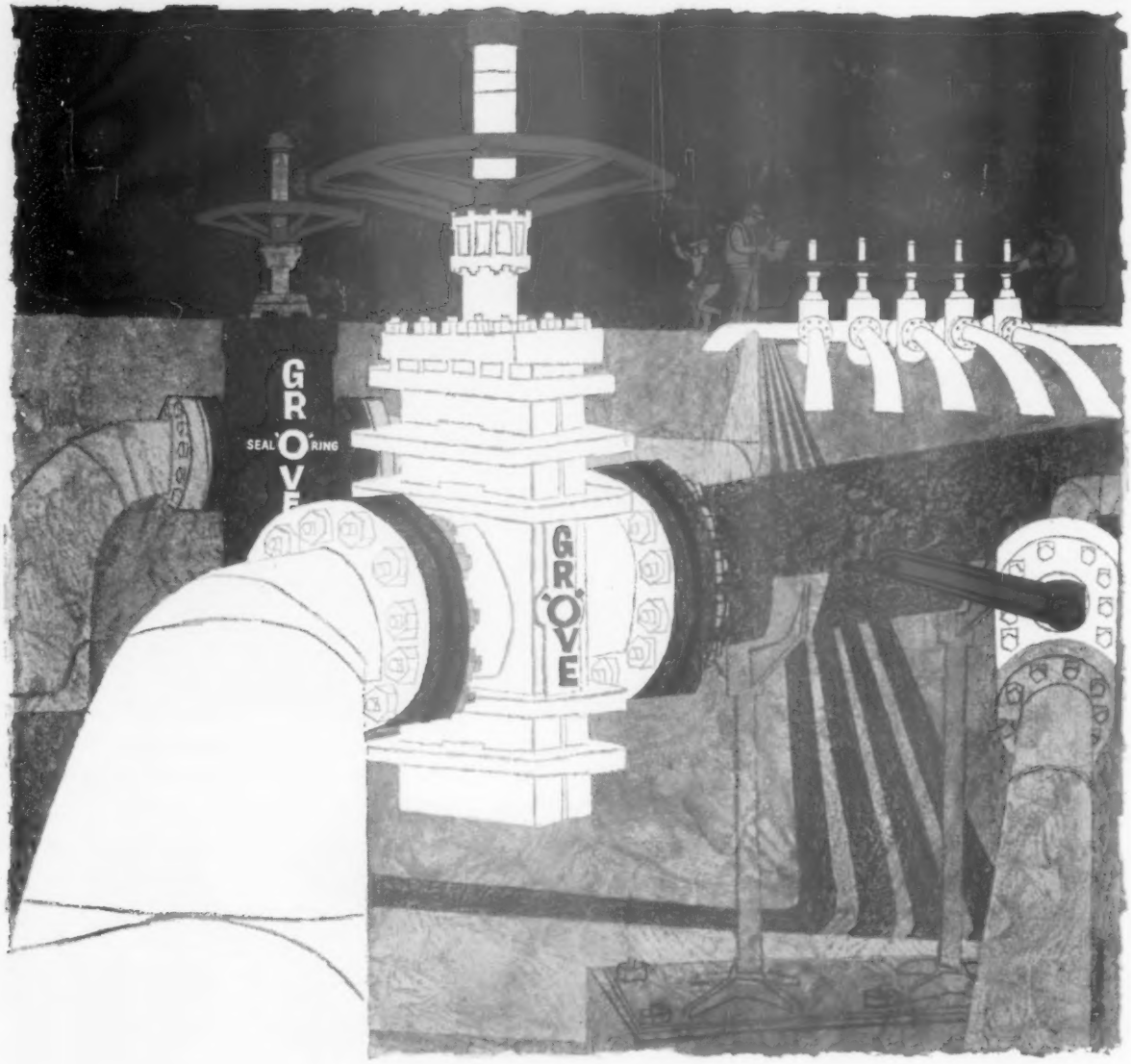
BEARING BOWER ROLLER BEARINGS SERVICE

After centuries of toil-oil!

YESTERDAY — a warm house demanded a strong back and plenty of attention to keep those early furnaces and stoves stoked up with coal — the principal source of heat for many decades. Then along came a labor-saving solution to this heating problem — the introduction of fuel oil.

TODAY — silently, efficiently, automatically, oil heats over 16-million homes in the United States. Annually, this country consumes nearly 2½-billion dollars worth of oil for home heating — making petroleum one of the most basic and vital household commodities. Texaco is one of the principal suppliers of fuel oil.

TEXACO



PIPELINE VALVES? GET GROVE

Whatever the service, there's a proven Seal-"O"-Ring® Grove valve ready for duty. G-3, G-4, and new G-5 series Grove gate valves are available in sizes and working pressures to suit your needs. And Grove valves never need lubrication! For complete details on any Grove pipeline valve, write for Catalog 541.

GROVE PIPELINE VALVES

GROVE VALVE AND REGULATOR COMPANY
A Subsidiary of Walworth
6529 HOLLIS STREET • OAKLAND 8, CALIFORNIA
Offices in principal cities throughout the United States

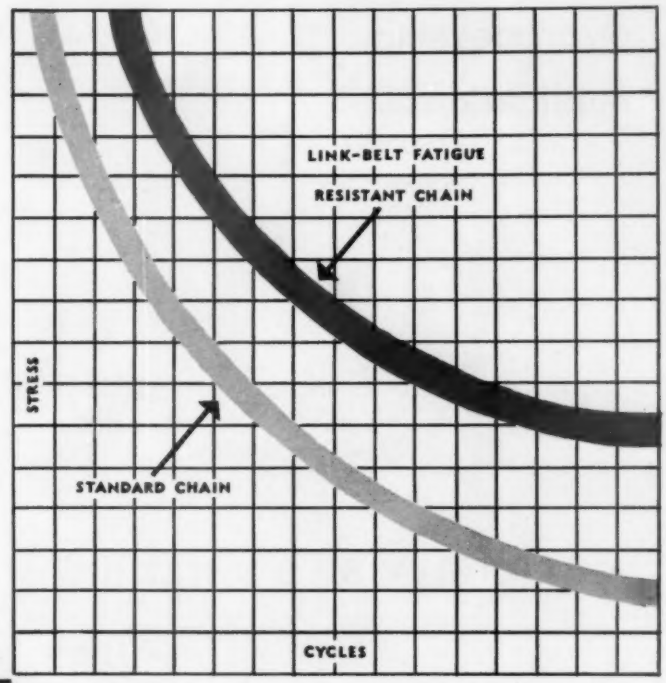
6322

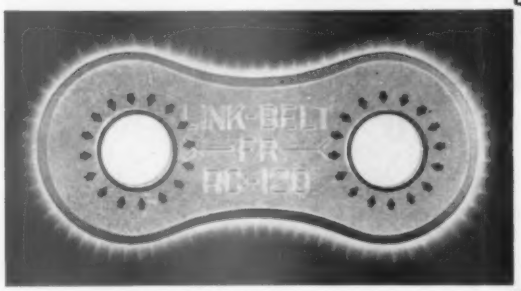
How important is LINK-BELT's FR® FATIGUE RESISTANT to roller chain life?

Fatigue Resistant processing of sidebars develops greater dynamic strength for hard-working oil field drives . . . increases endurance limit

If your drilling is all too often interrupted by failure of ordinary roller chain, sidebar fatigue may be your problem . . . and then the Link-Belt FR process is your answer! By concentrating resistant compressive stresses in the area around the pitch hole, Link-Belt adds substantially greater *dynamic strength* to its Precision Steel Roller Chain. The difference—shown in the chart at right—gives Link-Belt drives the ability to shrug off repeated high loads that otherwise may cause early failure.

Standard on Link-Belt oil field roller chain, FR is supported by many more "extras." Any leading supply store in the field will gladly explain their importance, and furnish you a copy of Link-Belt Catalog 2880.





U. S. Patent No. 2,517,497

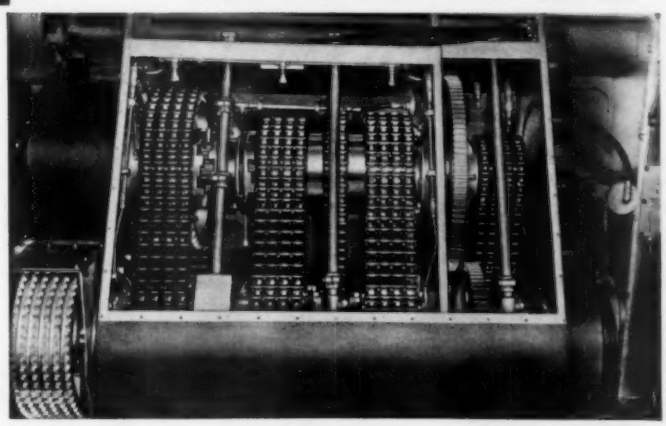
LINK-BELT

ROLLER CHAINS & SPROCKETS

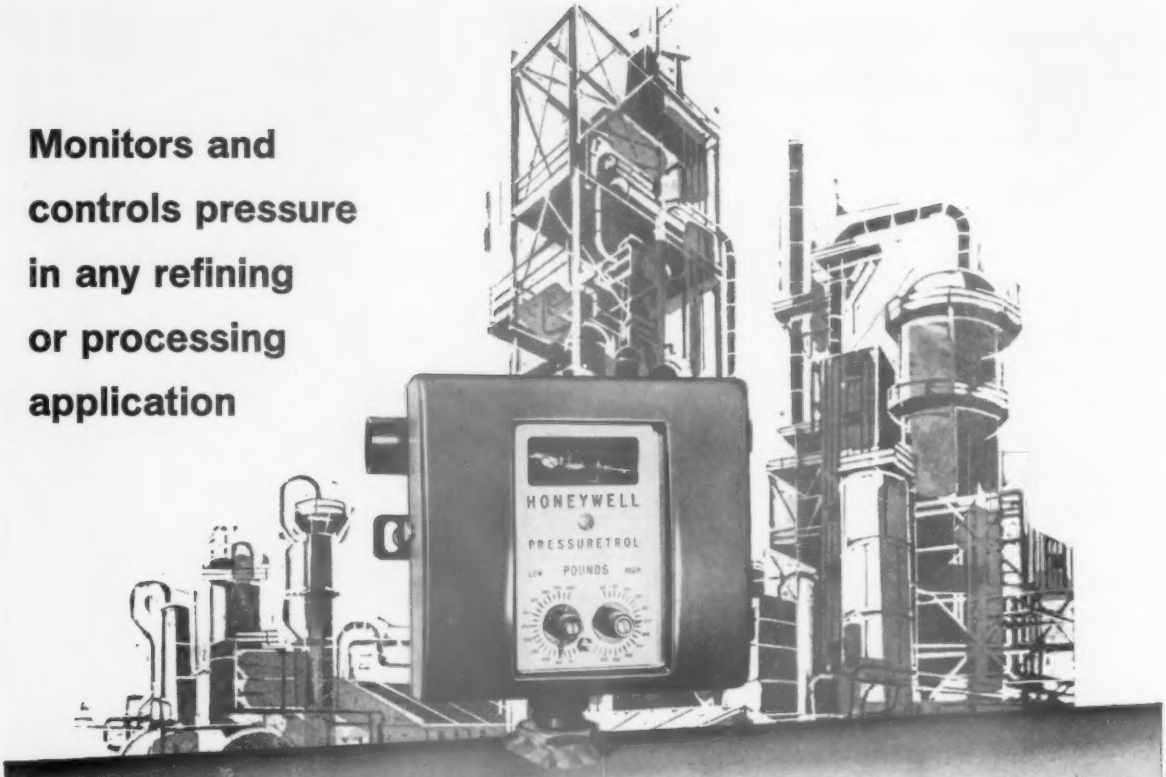
LINK-BELT COMPANY: Indianapolis 6, Houston 1, Dallas 21, Odessa, Tex., Shreveport, La., Los Angeles 33, Scarboro (Toronto 13); Export Office, New York 7. Distributors in All Fields. 15,343

GARDNER-DENVER 2100 DRAWWORKS uses Link-Belt multiple-width precision steel roller chain with FR-processed sidebars. Other important Link-Belt roller chain extras:

- SHOT-PEENED ROLLERS with greater fatigue life.
- PRE-STRESSING for load-bearing uniformity.
- E-Z ASSEMBLY to facilitate field installation.
- SHEPHERD'S CROOK COTTERS — won't shake loose.
- DOUBLE BOXING — most effective in the field.



Monitors and controls pressure in any refining or processing application



Honeywell's versatile Bourdon-tube PRESSURETROL*

- **Suitable for all gasses, fluids and steam**
- **Ranges from 30 to 3000 psi**
- **Standard and explosion-proof models available**
- **FM, UL, FIA approved**

Honeywell Pressuretrols precisely measure and control pressures of any fluid, gas or steam. They can be used to sound an alarm or control a valve, pump or compressor. These are heavy duty devices designed specifically for industrial use.

The Pressuretrol can be flush or surface-mounted on a panel, or installed directly on a pipe. Settings are made with one high and one low pressure knob conveniently located on face of the unit. The mercury switch can be easily seen through a protective glass window. Depending upon pressure range, bronze, stainless steel and beryllium copper Bourdon tubes are available. Choice of control to make on pressure rise or fall.

Model P428		Model P444	
Range (psi)	Maximum (psi)	Range (psi)	Maximum (psi)
30—300	375	20" vac—40	75
50—600	750	1—20	50
100—1000	1200	5—50	80
200—2000	2400	5—150	200
300—3000	2500		

No matter what your pressure-control need, Honeywell can supply it for you. Call your local Honeywell office or write Honeywell, Dept. OJ-3-41, Minneapolis 8, Minnesota. In Canada, write Honeywell Ltd., Seaside, Toronto 17.

See us in Sweet's 1960 Product Design File, Section 5b-Min.

*Trademark

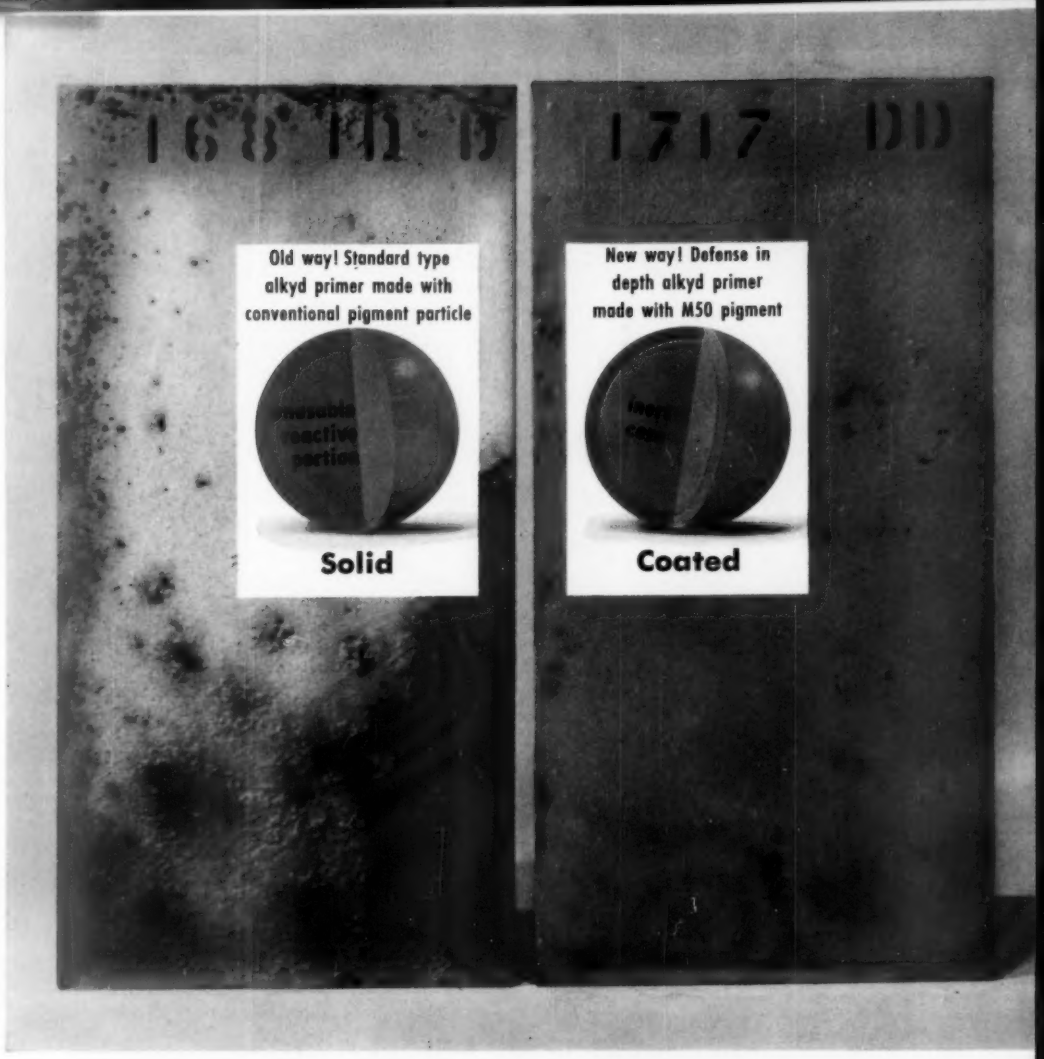
Honeywell

First in Control

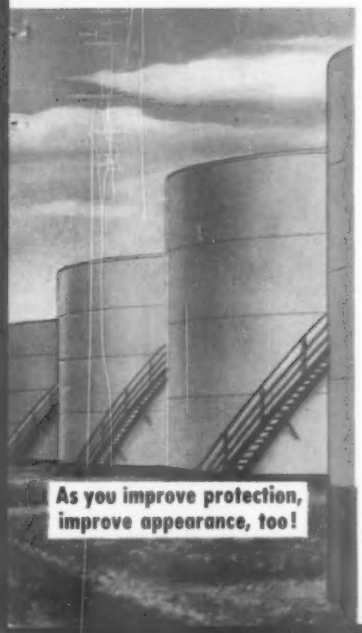
SINCE 1885

75th YEAR LEADING THE FUTURE

Never before such durable tank protection


Old way! Standard type alkyd primer made with conventional pigment particle
Solid
New way! Defense in depth alkyd primer made with M50 pigment
Coated

Proof tank paints with M50® pigment form rust-inhibitive films of outstanding strength and durability



Test panels like these *prove* what paints can do. And these two make it plain that paints containing *M50* basic lead silico chromate—a new National Lead rust-inhibitive pigment . . . form outstandingly strong and durable protective films.

Excepting the pigment, both primers shown on the test panels contain the same ingredients. Both are applied (2.0 mils, dry) on rusted and mill-scaled steel (to increase test's severity). Both have been exposed 12 months in industrial atmosphere (Perth Amboy, N. J.) and 12 months in normal atmosphere (Sayville, L. I.) at 45° South. You can see the effect.

A striking difference! Yet film strengthening proves to be only one of many improvements that *M50* pigment makes in metal protective paints for steel tanks and structures. Now—with new *M50* pigment—your regular paint suppliers can provide metal protective paints with outstanding advantages:

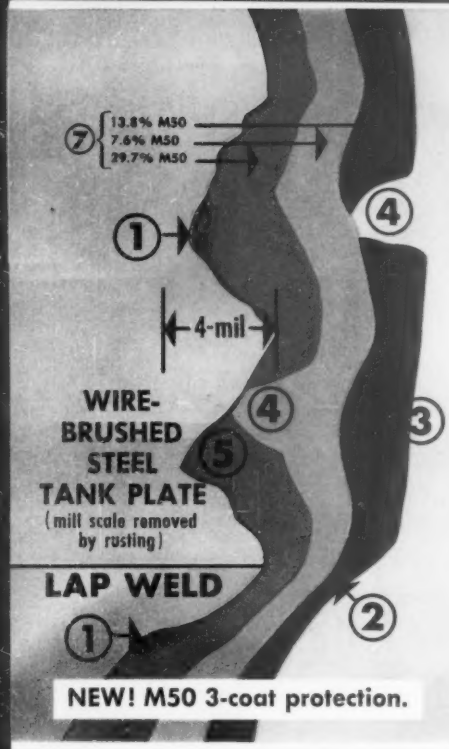
- Weather-resistant anti-corrosive primers.
- Intermediate and finish paints *with* exceptional rust inhibition but *without* bilging hazard in sulfur-laden atmospheres.
- Finish paints in a wide range of decorative colors that don't fade or wash out.
- Alkyd-type conventional and deep-coat paints with outstanding durability, package stability and sprayability.

What makes the difference? Basically the differences that make a difference in *M50* pigmented paints are inherent in the unique *M50* coated pigment particle itself (idealized particle shown above.) See, on the next page, the extra protections the *M50* particle provides in the dried film. See, too, how you can get the benefits of these new, much more durable, anti-corrosive paints.

M50 *an* **oncor** TRADEMARK *pigment development of*

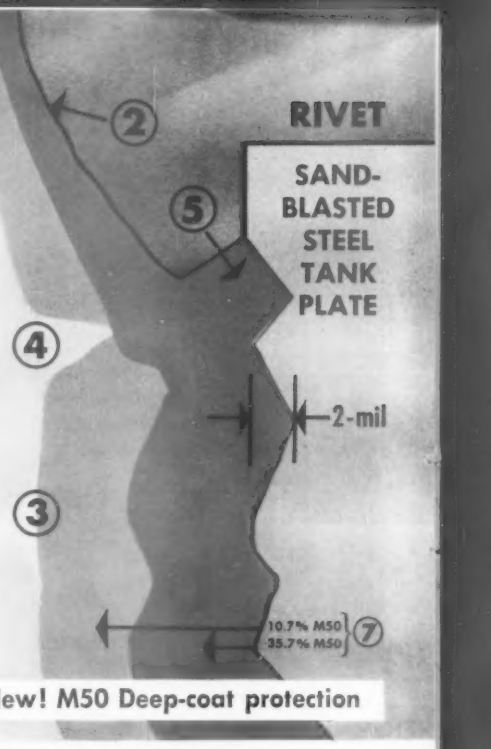
National Lead Company

111 Broadway, New York 6, N. Y.



NEW! M50 3-coat protection.

1. **Pockets of rust prove less harmful** on steel surfaces painted with conventional *M50* paints. Vehicles penetrate and isolate existing rust. *M50* particles stop rusting action.
2. **Where paint film lies thin** over tiny surface projections and sharp structural edges, the *rust-inhibitive* pigment content in all coats of *M50* paints provides extra protection.
3. **Just-right flow characteristics of** package-stable *M50* paints aid leveling on rough steel surfaces, promote smoothness, good appearance.
4. **Inevitable "holidays" in film** do not destroy protection. Again, *all M50* coats have both rust inhibition *and* weather resistance.
5. ***M50* paints "wet" well**, penetrate pits and crevices, carry *M50* protection to every part of these danger spots.
6. **Lightweight *M50* particle** aids formulation of new type deep-coat paints with *uniform* rust inhibition throughout the film and low sag characteristics.
7. **Every coat can have rust inhibition**—not just the primer. Note percentages of *M50* in dry films. What's more, for equal weights of corrosion-inhibitive pigment, *M50* primers contain 40-60% more corrosion inhibition by volume than non-*M50* primers.



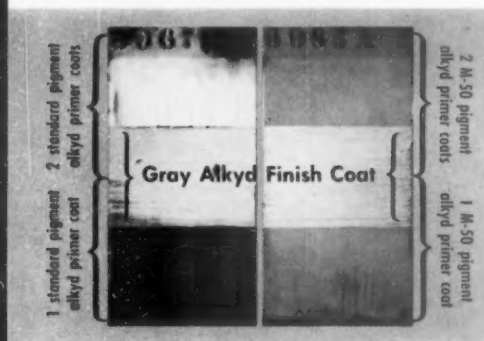
New! M50 Deep-coat protection

Sections through M50 Defense in Depth films show dramatic extra protection these new tank paints provide

Information on the preceding page proves that *M50* pigment paints form stronger protective films than anti-corrosive paints made with other rust-inhibiting pigments. The sections above show some of the ways in which these new paints perform better in the dry film. Below you will see *proof* that *M50* metal protective paints don't bilge, are unique for color stability and the color range in which they can be made.

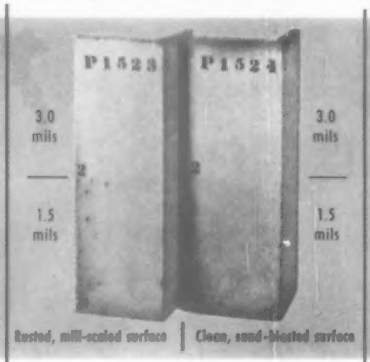
Hold the *M50* pigment particle itself responsible for all these improvements . . . *Basic lead chromate* is known for exceptional rust-inhibiting action. In the *M50* particle, this reactive business portion of the particle is coated on an inert core . . . where *all of it is available* to react. The coating is *fused* on—shows superior resistance to chalking, erosion, chemical action. Unusual tintability is due to the geometric configuration of the coated silica particle.

Why M50 Defense in Depth paints give anti-corrosion beyond all former concepts


2 standard pigment alkyd primer coats
Gray Alkyd Finish Coat
1 standard pigment alkyd primer coat
2 M-50 pigment alkyd primer coats
1 M-50 pigment alkyd primer coat

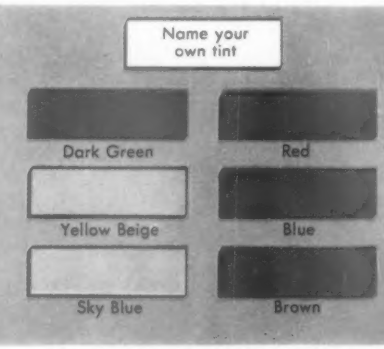
Exposed 9 years, 45°S. Each coat 1.5 mils

Proved corrosion and weather resistance



Exposed 4 years adjacent to refinery

Proved anti-bilging performance



Available in conventional and heavy-coat paints

Proved stability in wide range of colors

Are you concerned with tank or structure maintenance painting in your firm? If so, you are invited: (1) to visit National Lead's Sayville, L.I. test station, where you will see the results of the 20 years research that lies behind the *M50* pigment particle and the more than 10 years of exposure testing that lies behind *M50* pigment Defense in Depth paints; (2) to send coupon below for National Lead booklet, "Defense in Depth" and typical *M50* tank paint specifications.

Next time you purchase, specify *M50* pigment paints. Any paint manufacturer can supply you.

M50 Defense in Depth

National Lead Company,
111 Broadway, New York 6, N. Y.

Gentlemen: Please send me the "Defense in Depth" booklet together with typical tank paint formulas and color chips that I can use in specifying M50-type tank paints.

oncor TRADEMARK

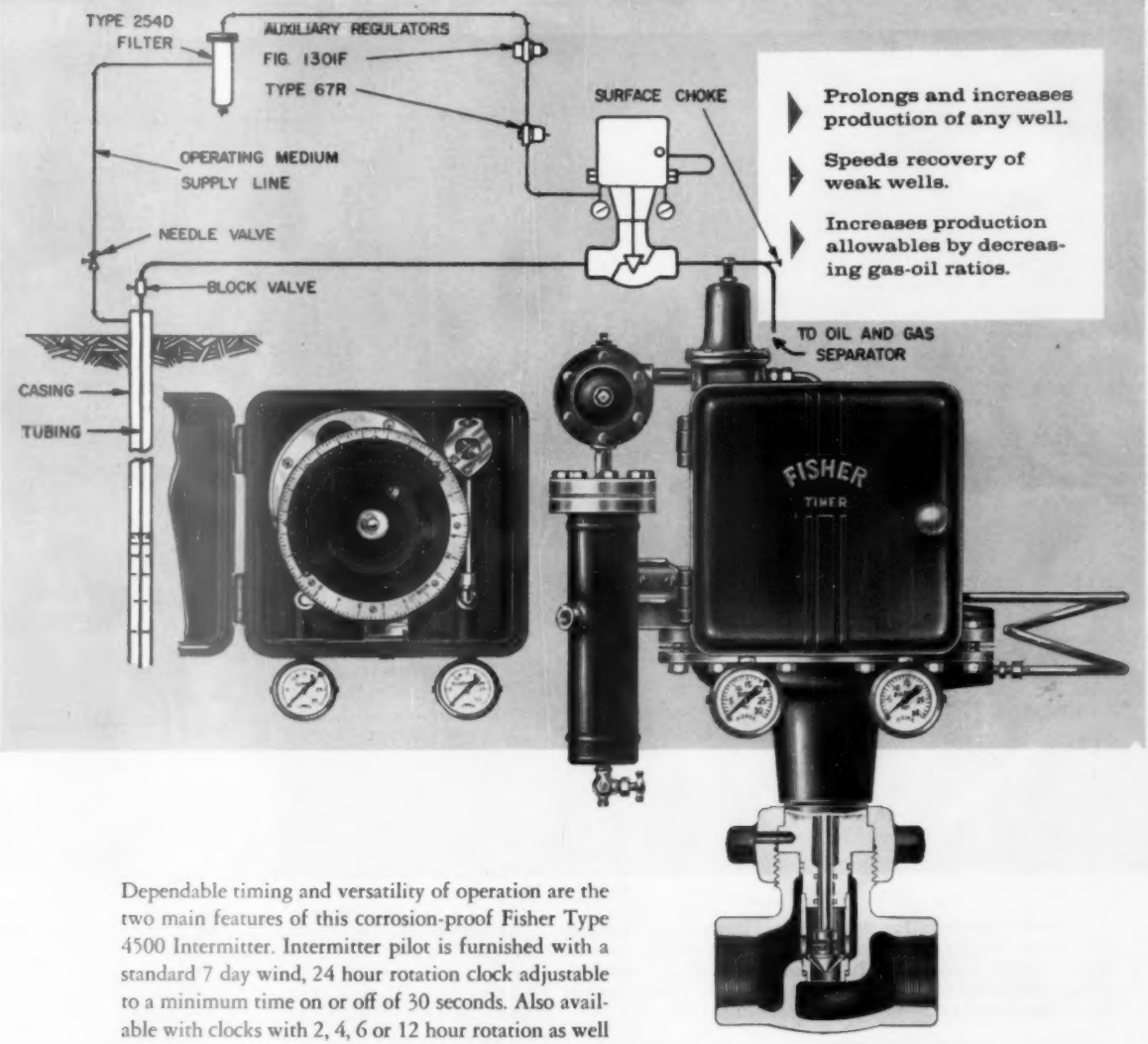
Name_____ Title_____

Firm or Dept._____

Address_____

City_____ State_____

Maximum production efficiency with Fisher's wellhead controls



- Prolongs and increases production of any well.
- Speeds recovery of weak wells.
- Increases production allowables by decreasing gas-oil ratios.

Dependable timing and versatility of operation are the two main features of this corrosion-proof Fisher Type 4500 Intermitter. Intermitter pilot is furnished with a standard 7 day wind, 24 hour rotation clock adjustable to a minimum time on or off of 30 seconds. Also available with clocks with 2, 4, 6 or 12 hour rotation as well as clocks with electric drive. Reverse action can be easily achieved by simply rotating relay cap 180°. Complete information is available on the Fisher Type 4500 Intermitter by requesting Bulletin O-4500.

FISHER TYPE 4500 INTERMITTER
Mounted on a Type 125-P Field Valve.

IF IT FLOWS THROUGH PIPE ANYWHERE IN THE WORLD . . . CHANCES ARE IT'S CONTROLLED BY

FISHER GOVERNOR COMPANY

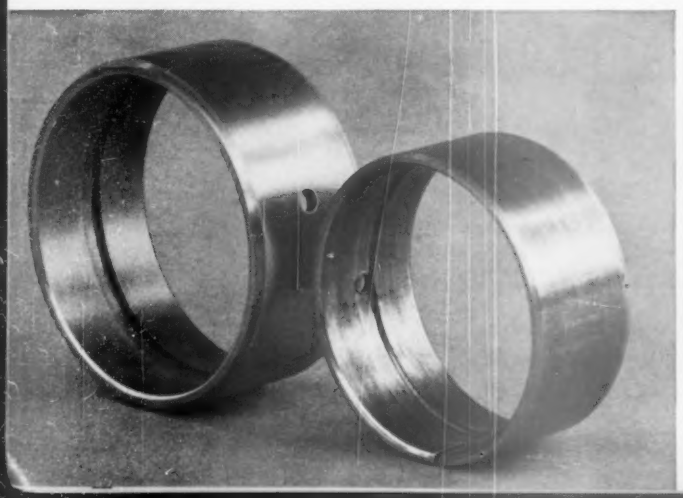
Marshalltown, Iowa / Woodstock, Ontario / London, England

SINCE 1880

Onan Electric Plants are when this independent

Big, beefy bearings for longer life. (Lower left) double-size Onan bearings vs. small bearings (right) used in many other makes. Larger bearing surface reduces wear, stretches time between overhauls. Onan builds up to performance—never down-to-a-price.

The engine that ran equivalent to 487,888 automobile miles. Here's endurance no auto could begin to match. Onan engine #1068 was operated for 12,197 hours. It was stop-started 100 times. At test's end #1068 and generator were delivering their stated output.



Performance Certified only tester says O.K.

His job is to provide a double-check on Onan's own tests and testing methods

The man at the left is an expert from an independent testing laboratory. On the job, he believes nothing except what his trained eyes, ears and scientific testing instruments tell him.

He, and others like him, pay frequent surprise visits to Onan factories. He can pull any Onan plant off the test line. Put it through its paces. Recheck the checks Onan engineers and inspectors have already made. He has authority to pull a whole series of plants off the line if he finds one fault. He does all this even though every Onan plant is tested for hours by Onan personnel *before it is shipped.*

Onan takes these special precautions to make *doubly* sure that you get all that you pay for, and more, when you own a Performance Certified Onan. For more details—and an analysis of your primary and stand-by power needs—see the Onan distributor nearest you. He's listed in the telephone classified section in all major cities. Or write direct.

ONLY ONAN GIVES YOU THIS GUARANTEE

PERFORMANCE CERTIFIED
We guarantee that when properly installed and operated this Onan electric plant will deliver the full power and the voltage and frequency regulation promised by its nameplate and published specifications. This plant has undergone several hours of running-in and testing under realistic load conditions, in accordance with procedures certified by an independent testing laboratory.
D. W. ONAN & SONS INC.
Minneapolis 14, Minnesota
Onan

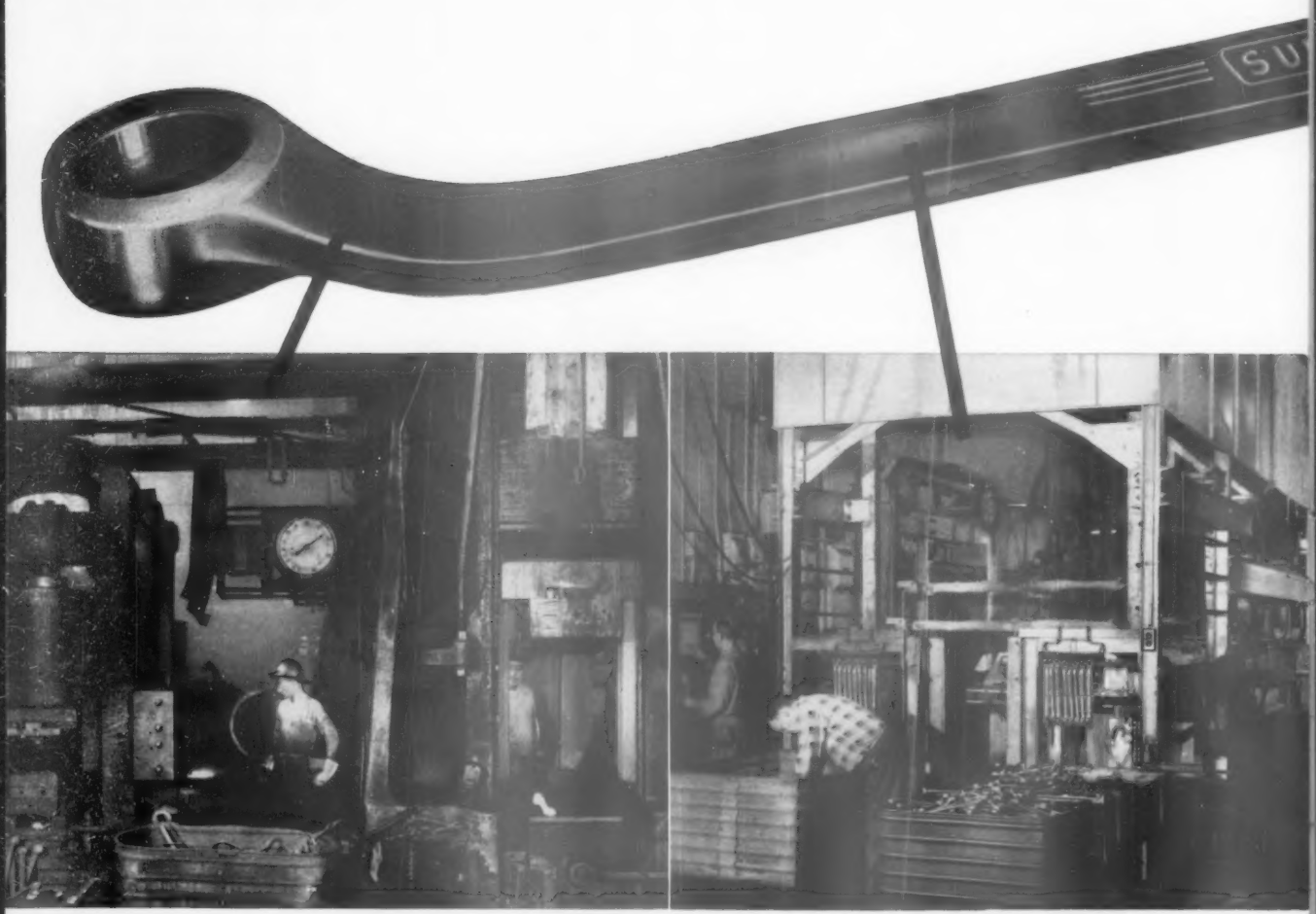
Onan®

World's Leading Builder of Electric Power Plants

D. W. ONAN & SONS INC., 2514 UNIVERSITY AVE. S.E., MINNEAPOLIS 14, MINN.

It's a Push-Button World at Williams

No other manufacturer has the combination of automated equipment to make the finest fit, feel and finish in wrenches!



Forging temperatures for each of Williams' 65 hammers are automatically controlled by sensitive pyrometric instruments which comply with rigid aircraft specifications, MIL-Q-5923C (USAF). The result is tough, fine-grain forgings every time. Die matching is held to close tolerances for maximum structural uniformity.

Special conveyorized heat-treating equipment automatically heats and quenches forgings in a series of salt baths to prevent decarburization and dimensional distortion often found in other wrenches. It further develops the relationship of toughness and hardness to the optimum.

Feel and finish are refined on this automatic profiling machine. All rough edges are completely removed. Wrench handles are profiled to uniform dimensions and are blended into the heads for greatest strength.

Here wall thicknesses are machine-controlled to exact concentricities. This extra step produces heads offering uniform clearances from wrench to wrench... pattern to pattern.

Developed specially for Williams, this three station transfer machine drills, broaches and chamfers. Box openings are machined to tolerances well within industry standards for long-lasting, sure-grip fit.

WILLIAMS' SUPERIOR DESIGN OUT-PERFORMS EVERY OTHER WRENCH

12 Point openings, broached to close tolerances, permit complete nut rotation in 30°

Modified rectangular handle-design offers maximum strength and comfort.

Wall thicknesses designed for maximum strength with greatest clearance.

Satin finish for safe, firm grip. No dirt-catching ornamentation.

Height of box wall correctly proportioned for all nut sizes and series.

Offset forged-in from top of box for the maximum obstruction clearance.

Williams Wrenches measure longer than industry average for extra leverage

MR. WRENCH says:

SEND FOR THIS NEW JAM-PACKED CATALOG No. 304. Lists 4530 stock tools and forgings...wrenches of all kinds, power sockets, clamps, tool holders, hoist hooks, eye bolts, and many more...

THE BROADEST LINE OF ITS KIND

INDUSTRIAL DISTRIBUTORS SERVING INDUSTRY ECONOMICALLY THE RIGHT HAND OF PRODUCTION

WILLIAMS

TOOLS OF INDUSTRY

J. H. WILLIAMS & CO.
DIVISION OF UNITED-GREENFIELD CORPORATION
415 Vulcan Street, Buffalo 7, New York

Mr. Wrench: Please send me your new illustrated catalog No. 304.

NAME_____ TITLE_____

FIRM_____

ADDRESS_____ ZONE____ STATE_____

Professional Guidance Is Your Best Assurance of Success

With some luck, a lot of bass, and plenty of time, who needs a guide? And with twenty producing days a month, 3½ per cent money, and a quick payout, it was a lot easier to get ahead in the oil business. But, when you find that conditions aren't as you would have chosen, whether it's because only a few bass are hiding in the lake or because of drastically cut allowances, the time has come to call in the pros.

The Oil and Gas Loan Department of The National Bank of Commerce is ready to help you now. There are many ways to help, and lending money is only one function of this department. The Oil and Gas specialists in this department have already helped so many others. They've helped them back on the road to a profitable operation by helping them tighten their organization, cut costs by paring fat and not muscle.

The time may well have come when you must start living under the new conditions in the oil business. There's no better way to get started than by beginning to work with the Oil and Gas Loan Department of The National Bank of Commerce.

The oil and gas business is going to be around for a long time to come. Our experience and knowledge of all business can help you to get over the next few years, can help you to keep your organization intact and in good shape. Knowing the oil and gas business is one more reason so many leading independents are with us now. They need the best in banking, and the best in banking costs no more.

THE NATIONAL **BANK** OF
COMMERCE
OF HOUSTON

EXPANDING NOW TO MAIN, RUSK, TRAVIS AND CAPITOL.

MEMBER FEDERAL DEPOSIT INSURANCE CORPORATION

WE'LL ADMIT

there are many claims about many wellhead hook-ups and components. But if you want to take the puzzle out of your production equipment, ask the O-C-T representative nearest you about "The Standard." It is simply a combination of an O-C-T Casing Head, O-C-T Tubing Head, master valve of your choice, and O-C-T flow control.

O-C-T Casing Heads are designed for flexible application under every well condition and feature increased economy through safety and rig-time savings.

O-C-T Tubing Heads are available with complete ranges of hangers. An example is the popular "T-16," a full open type with API flanges to receive flanged blowout preventers or master valves to permit the hanger to be landed. It is adapted to receive the threaded "T-16" Hanger or alternate types.

O-C-T Flow Controls combine in an integral, one piece casting, a device performing the functions of a tree cross or tee, wing valve, adjustable or positive choke and the upper bottom hole pressure connection adapter. These Flow Controls effect economies in cost and weight.

In the "O-C-T Standard," simplicity, durability and economy are built-in features.

OIL CENTER TOOL CO.

SUBSIDIARY OF FOOD MACHINERY AND CHEMICAL CORPORATION

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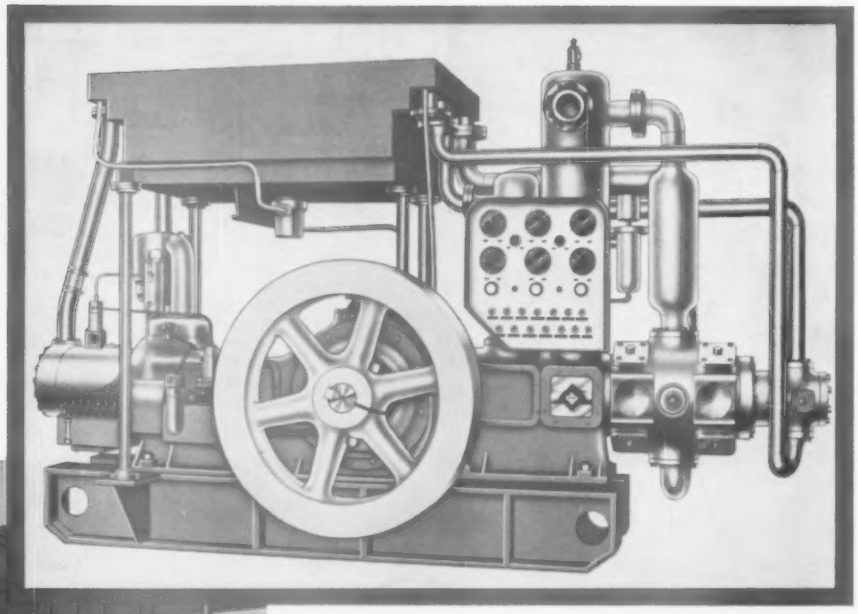
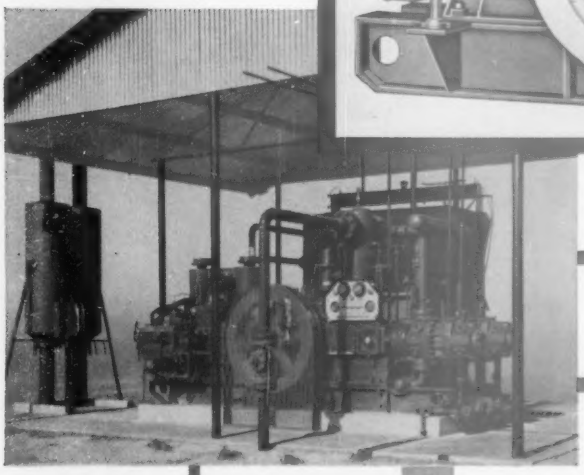
How to keep WILDCATTING out of Purchasing



Shown above — the new DPC-60
Single Cylinder Engine-Compressor



DPC-230 Twin-Engine Compressor

There is enough gamble involved in the oil business without carrying it into the producing equipment phase.

Ajax equipment — engines - pumps - compressors — have proven themselves through the years.

Dependable — economical — and backed with conscientious service.

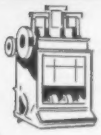
You may pay a little more simply because they are worth more.

Always a full dollars value in an Ajax product — always.

SEND FOR DETAILED ILLUSTRATED TECHNICAL BULLETINS . . .

AJAX

AJAX COMPRESSORS



AJAX . . . also builders of ENGINES . . . PUMPS

AJAX IRON WORKS CORRY, PENNSYLVANIA

OIL FIELD DISTRIBUTORS: The National Supply Co., Pittsburgh, Pa.
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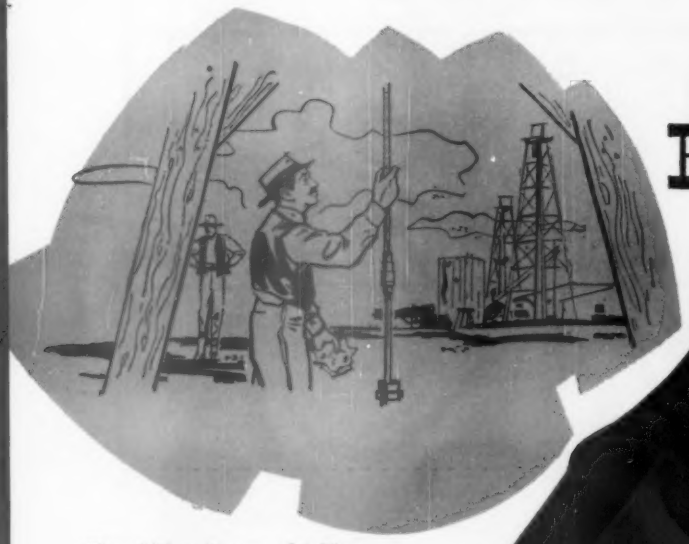
JONES

FIRST IN 1894...



The oldtimer's way of telling how a well was pumping was by feeling the polished rods. Long ago Jones developed more scientific methods to learn about the mechanics of pumping with sucker rods.

FIRST TODAY...

A good many years ago Jones developed a wall weighing dynamometer plus the technical knowledge to diagnose the pumping problems of troublesome oil wells and to suggest remedial action. This is the type service you can expect from a **Sucker Rod Specialist!**

...because we're Sucker Rod Specialists!

There are four
JONES JOB-ENGINEERED SUCKER RODS...
a type for every pumping need!

THE S. M. JONES COMPANY

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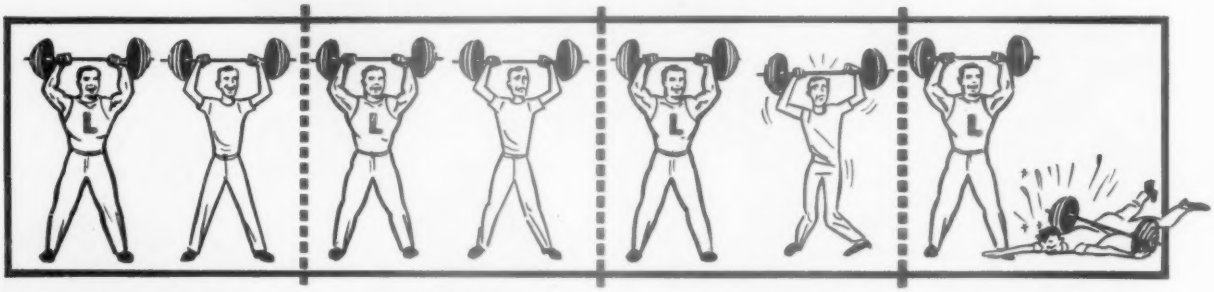
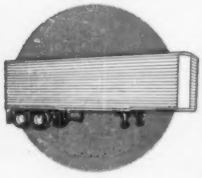
has been the LUFKIN motto from the very beginning . . . a policy that has given LUFKIN units a reputation for UNSURPASSED ENDURANCE and PERFORMANCE . . .



GOOD ENOUGH | WE WONDER . . . | . . . LATER | WUPS

PUMPING UNITS

GAS ENGINES



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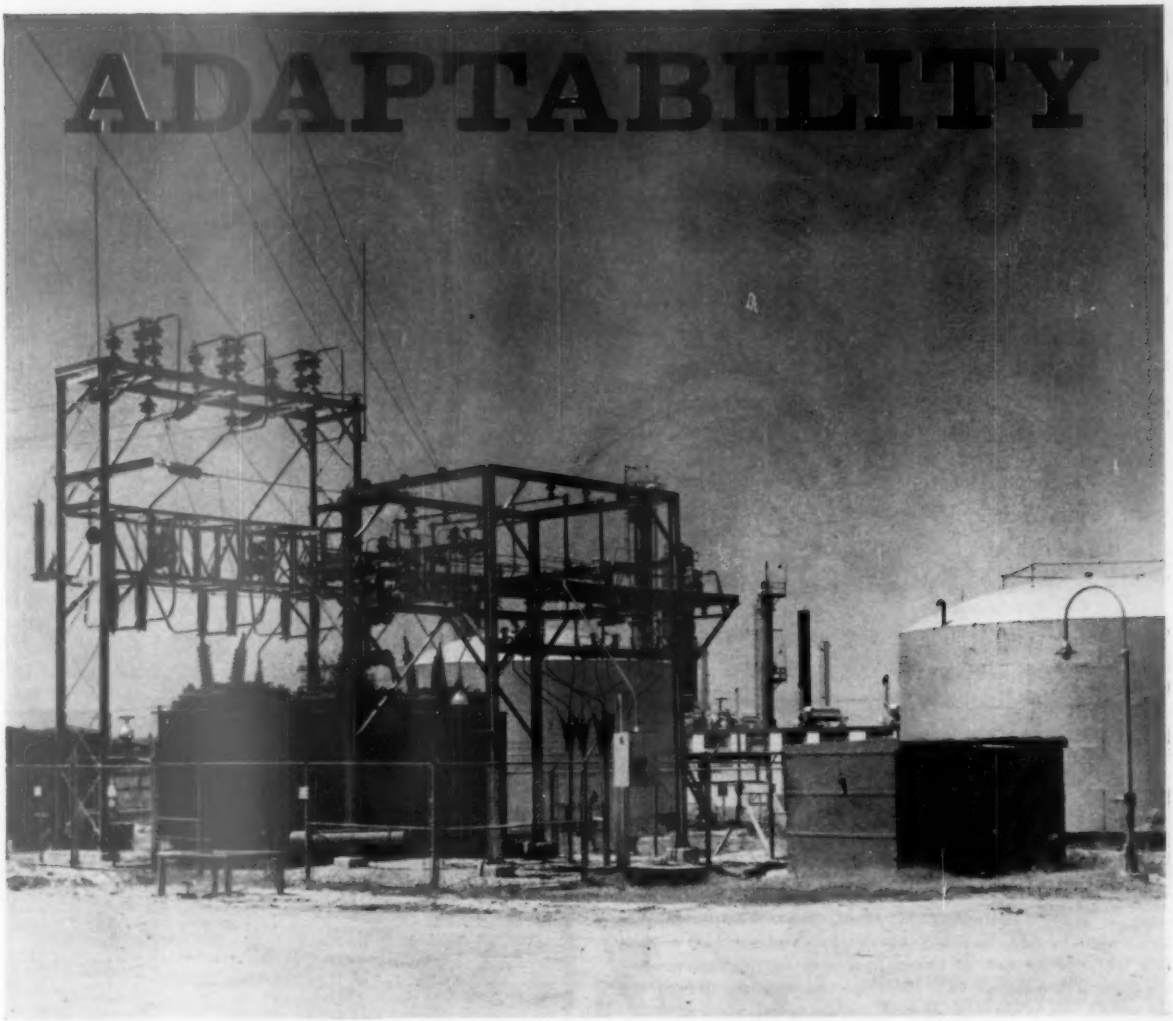
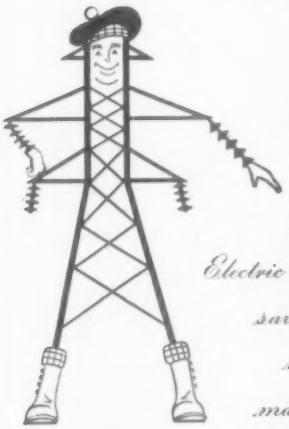
You can depend on purchased electric power for

ADAPTABILITY



This mainline crude oil station was converted to purchased electric power.



Purchased Electric Power . . . saves money, manpower, maintenance, and serves you better automatically

Typical of money saving installations is this new crude station using utility electric power

This modern station using three 500 hp and two 150 hp motors and 22 electrically operated valves is evidence of the trend to purchased electric power for ultimate economy. Whether your operation is pipeline, refinery or production it will pay you to investigate the possible savings of utility electric power. Call your nearest utility electric power company today.

Petroleum Electric Power Association P. O. BOX 35006, DALLAS 35, TEXAS

engine power
BY CATERPILLAR

Cat G342... lowest operating costs, highest output for its size of any natural gas engine on the market

The Cat G342 Natural Gas Engine is the *lowest cost* gas engine available both in initial cost and over-all operating cost. It produces 235 *continuous* horsepower @ 1300 RPM.

Because the six-cylinder G342 is built on a basic diesel engine block, it operates continuously at full HP *without derating*. Only pistons and fuel systems have been changed for operation on natural gas.

Available in compression ratios of 10.5:1 or 7.5:1, depending upon type of fuel to be used, the G342 is built with the dependability and economy that have made Cat Engines famous. With the 10.5:1 ratio these engines use only *7000 BTU per brake horsepower-hour!*

This Caterpillar G342 Natural Gas Engine powers a Chicago Pneumatic gas compressor near Beeville, Texas, for Northern Pump Company of Minneapolis, Minn. Lease Pumper Marvin Rabe stands beside the G342 which pumps one to two million cubic feet per 24 hrs. of excess gas into oil producing sand to maintain pressure. This prolongs the flowing life of the four producing wells served and increases ultimate recovery of oil from the field.

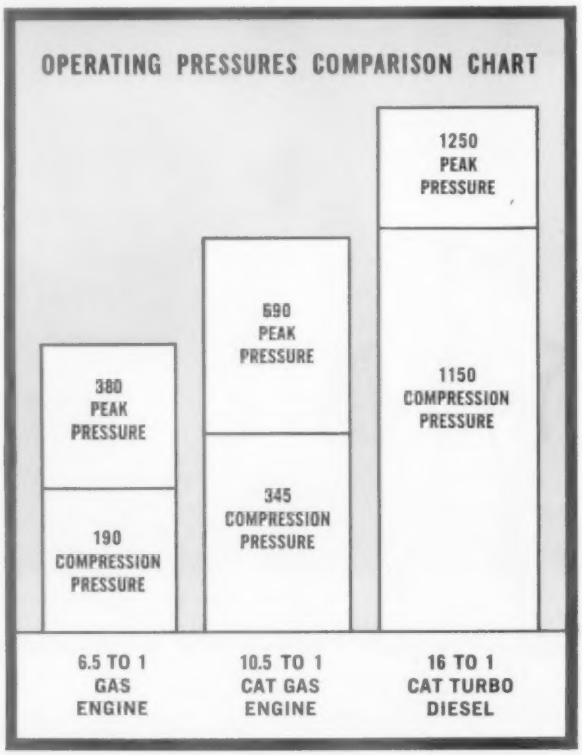
Specify Cat power when ordering your oilfield equipment. Caterpillar Natural Gas Engines are available in 6, 8, or 12 cylinders from 210 to 470 HP. See your Caterpillar Dealer for help in selecting the right engine for your needs.

CATERPILLAR

Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

Engine Division, Caterpillar Tractor Co., Peoria, Illinois, U.S.A.

Caterpillar operating pressures are about four times that of other make gas engines. To derate them to 65 per cent is not necessary since the engine is already operating well within the normal peak pressure load of 1250 PSI for which the engine is designed. Since other make gas engines are designed for peak operating pressures of approximately 380 PSI, it is necessary to derate them to provide reasonable engine life.



An important message for the man who buys

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Produced in accordance with A.P.I., A.S.T.M. and many other international standards, Sumitomo pipe in all sizes and grades is exported to every major area in the world. With half a century of tubular steel production behind it, Sumitomo's modern mills turn out a complete range of seamless and welded steel pipe, including oil country tubular goods, water and gas pipe, scaffolding pipe, special alloy-steel pipe for boilers, etc. Write for our illustrated catalogue.

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GIVE PRODUCTION TOOLS

A CHANCE TO WORK!

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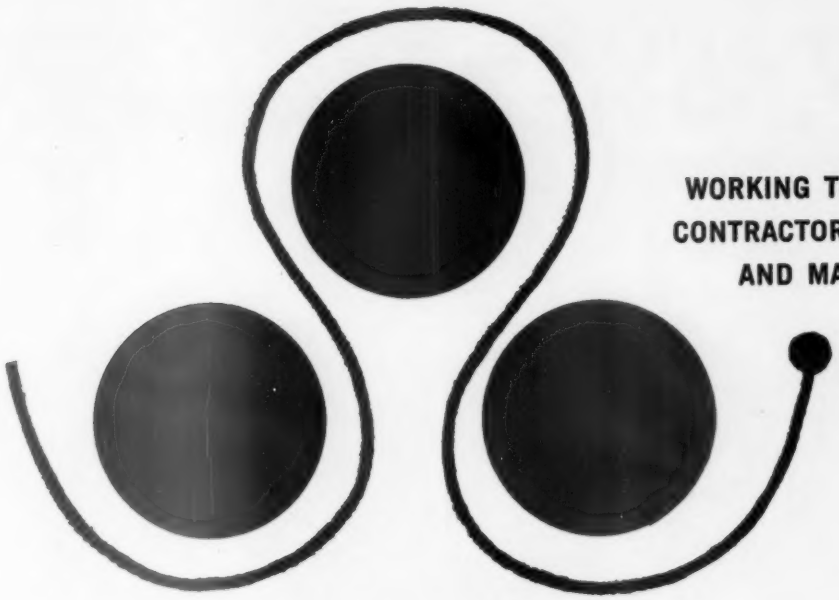
Save hours of rig time, needless expense with a Bowen Casing Scraper. Rust, mill scale, cement, perforation burrs, and other obstructions can prevent proper operation of down-hole tools, ruin composition or rubber materials, prevent passage of close-tolerance equipment. A Bowen Casing Scraper removes such obstructions, leaves the inside of your casing clean and smooth.

Scrape up or down. Blades give full 360° coverage, never deflect or miss patches of cement, rust or scale, never skip over perforation burrs. Blades are held firmly from the inside of the tool, cannot be lost in the hole, are easily changed in the field.

Ask for Bowen Casing Scrapers. They're available in every drilling and producing area. Write for descriptive literature.

BOWEN

Bowen Itco, Inc. P. O. Box 4587, Houston 13, Texas



WORKING TOGETHER... CONTRACTOR, PRODUCER, AND MAGCOBAR

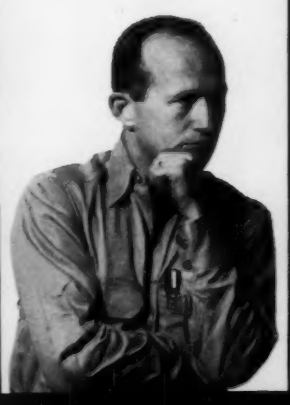
plan mud programs for pay and profit

High drilling costs can be cut by efficient use of drilling fluids. The right drilling chemicals, **used right** by Magcobar engineers, can help increase penetration rates, save on trips and bits, reduce materials needed, and save on equipment and manpower.

But, to make sure that the mud program is the most efficient, it must be planned from the beginning. And, because it must deal with many factors, it can be developed only with the close cooperation of producer, contractor, and Magcobar engineer. A sound mud program must be based on product performance, formations to be drilled, and, very important, type of equipment to be used.

By working together, a planned mud program can be developed to make full use of the money-saving advantages of Magcobar Technology. This Technology formulates special drilling fluids to reduce or prevent damage to the pay, resulting in quicker completion, higher production, and less need for expensive stimulation work. Magcobar Technology can help you as a contractor to drill wells more cheaply, can help you as a producer to have better wells. Drill your next wells with Planned Mud Programs with Magcobar.

Magcobar
Complete
DRILLING MUD SERVICE



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GASO DISTRIBUTORS BRING GASO SERVICE TO YOUR BASE OF OPERATIONS

We screen and pick our distributors with the utmost care. We bring their organizations to Tulsa for thorough training in oil-industry pumps and their application. We insist that they carry stocks of Gaso Pumps and parts.

Result: Complete Gaso service at your doorstep. Time-saving. Convenient. Still another explanation of the worldwide preference for Gaso Pumps.

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for every oil industry need

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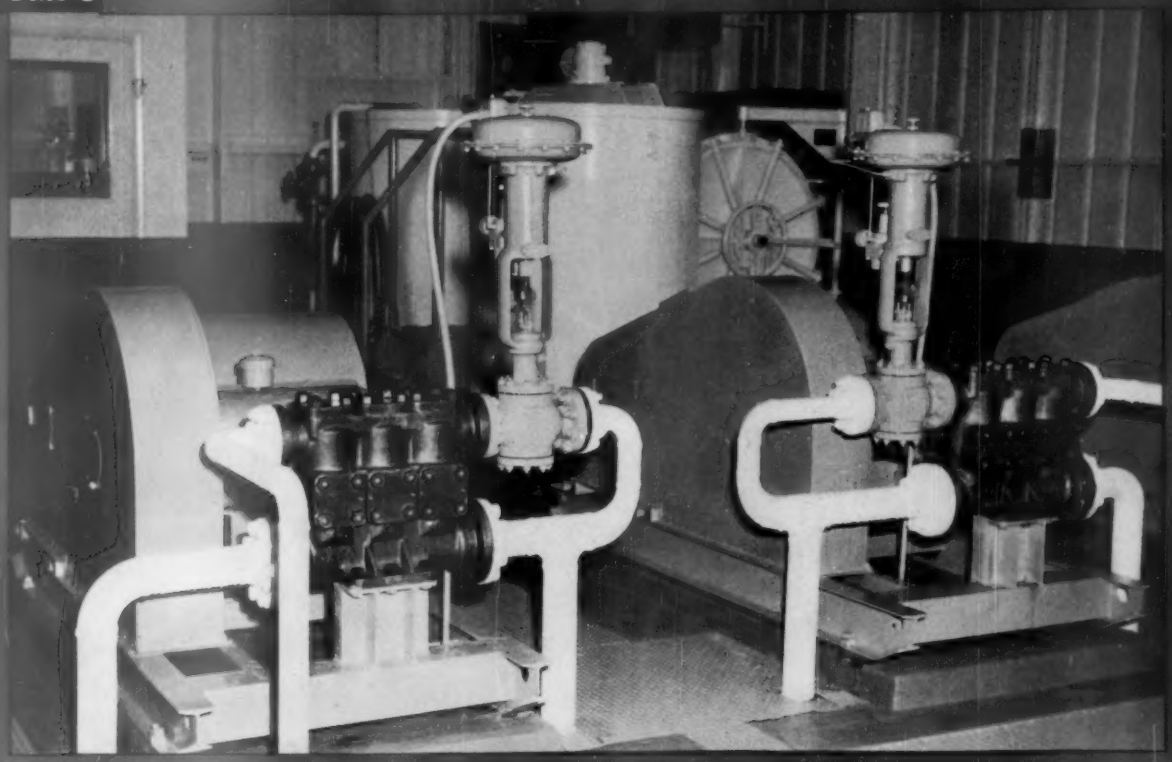
GASO PUMPS

WHAT'S BACK OF GASO LEADERSHIP IN

WATER FLOODING?



There's a Single-Word Answer: PERFORMANCE

The photograph shows one of a steadily mounting number of Gaso installations in water flooding service.

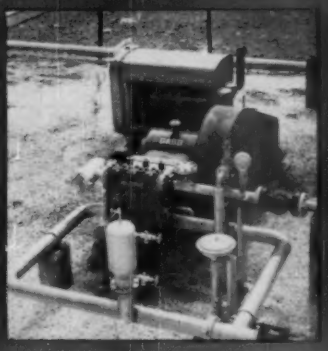
The injection pumps (3) are Fig. 3365, 1¾" x 3" Gaso Horizontal Triplex Plunger Pumps, driven by 40 HP 1200 RPM electric motors.

The fluid ends are of aluminum bronze fitted with ceramic plungers, non-adjustable type plunger packing (in both power and fluid ends) and Bakelite insert type valves mounted on Monel valve seats.

Each of the three pumps, operating at 350 RPM, delivers approximately 1075 barrels a day at 1500 pounds discharge pressure.

Complete adaptability to the job plus GASO design throughout is a time-tested guarantee of thoroughly dependable service extending far beyond the normal life expectancy of pumping equipment.

In the GASO line you will find the effective answer to any pumping problem associated with water flooding. Write for our 1960-61 catalog, or get in touch with our nearest distributor.



Gaso Pump in salt water disposal service in Louisiana

GASO PUMPS

for every oil industry need

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TASTE IT . . .

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. . . is with a Johnston Drill Stem Test. Gives you information on which you can base a decision and be absolutely sure. It removes all doubt, actually puts you in touch with the formation. • Don't chance setting casing on a dry hole — don't pass up a producer.

Test to be certain of your well.

Get the job done faster and better, at less cost.

You get more from a Johnston Test. Call Johnston!

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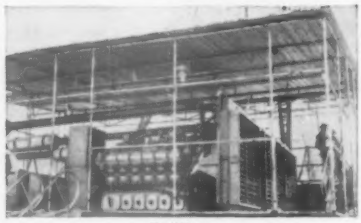
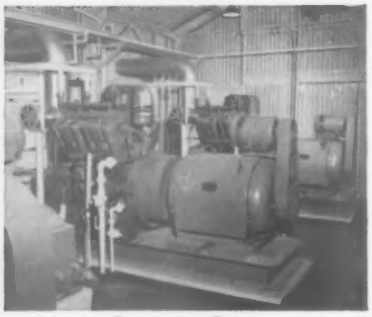
Compressor

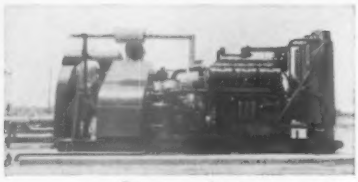


Drilling

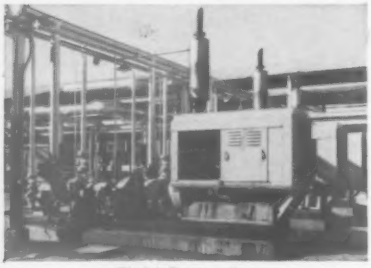


Generator Drive

Pipe Line

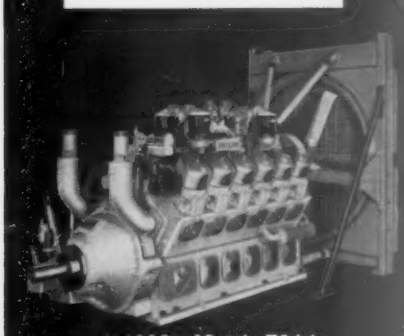


Repressuring

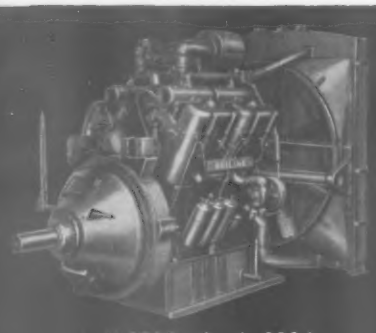


Field Processing

Transport



L-4000—12-cyl., 706 hp



H-2000—8-cyl., 300 hp

F-1500—6-cyl., 230 hp

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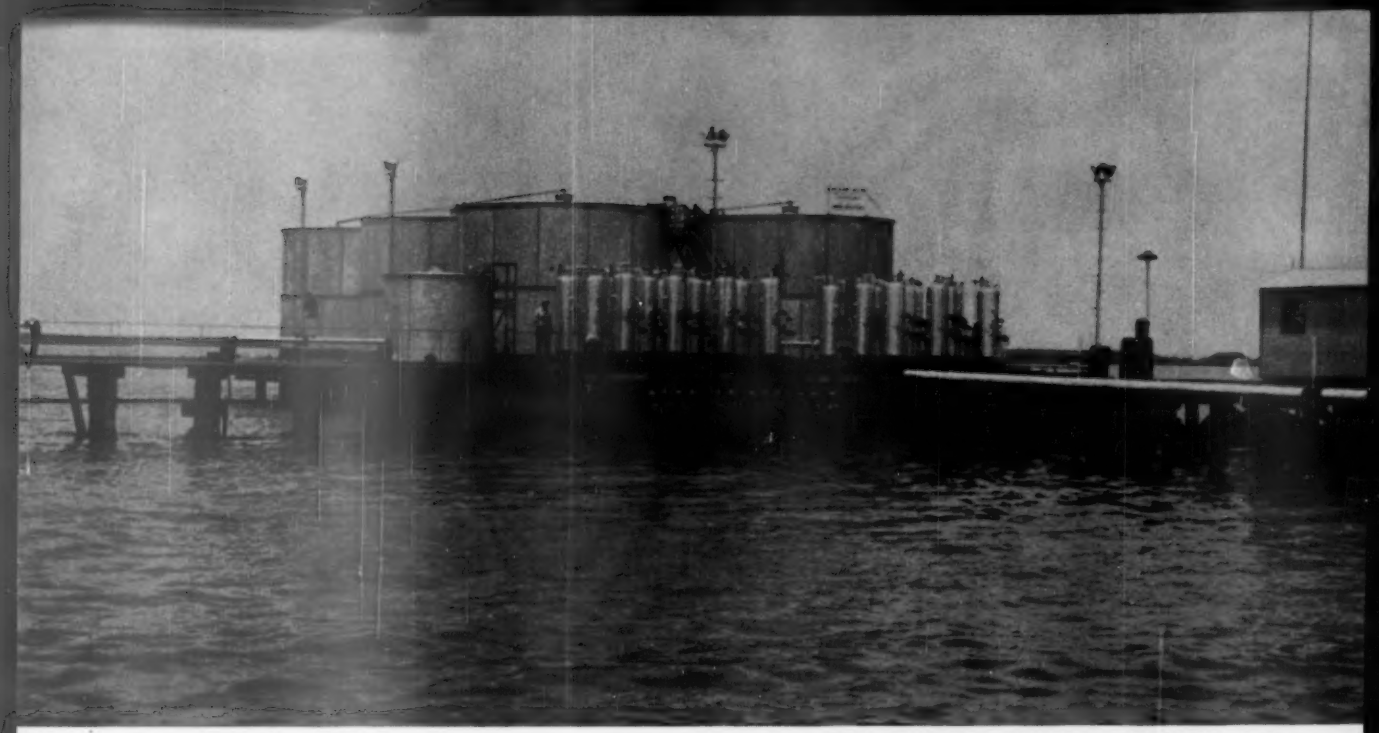


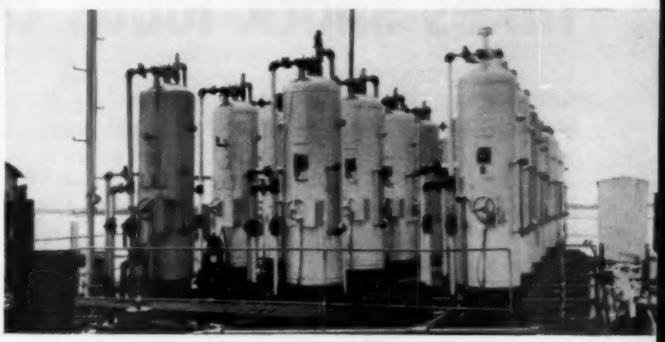
Individual well metering pays off in greater efficiency for this South Louisiana Operator

This battery of 24 Rolo Metering Separators in the South Pass Block 24 Field, Plaquemines Parish, Louisiana, gives continuous data on each well in the block and permits commingling of production and consequent savings in tankage.

From this single platform, trouble at any single well can be pinpointed rapidly with minimum effort. Individual well production figures are available at all times, and not just during a short, periodic well test. In fact, periodic well testing is eliminated, which means savings in equipment and more efficient utilization of manpower.

Rolo Metering Separators take no more space and are comparable in cost to ordinary separators without meters. The units shown are two-phase oil and gas separators with built-in dump type oil meters. They offer maximum accuracy and dependability. Thousands are in service all over the world.

Rolo also offers three-phase metering separators which separate gas, oil and free water and meter the oil and water by separate meters—all in one vessel. (Rolo Automatic Samplers are perfect accessories to determine emulsified water cut.)



Most land installations allow the location of Rolo Metering Separators at the wells, offering savings in flowlines through commingling. Contact your representative for the free booklet, "The Comparative Advantages of Individual Well Metering Over Conventional Production Systems."

Both offshore and on land, today's need for maximum data on reservoirs and individual wells makes *continuous individual well metering* more desirable than ever. For *metering* along with *separation*, specify Rolo Metering Separators, pioneered and perfected by the leader in oil well metering.

Contact your nearest Bethlehem representative for information and prices on Rolo products. In California, Howard Supply Company. In Canada and for export, see below.

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SUPPLY DIVISION
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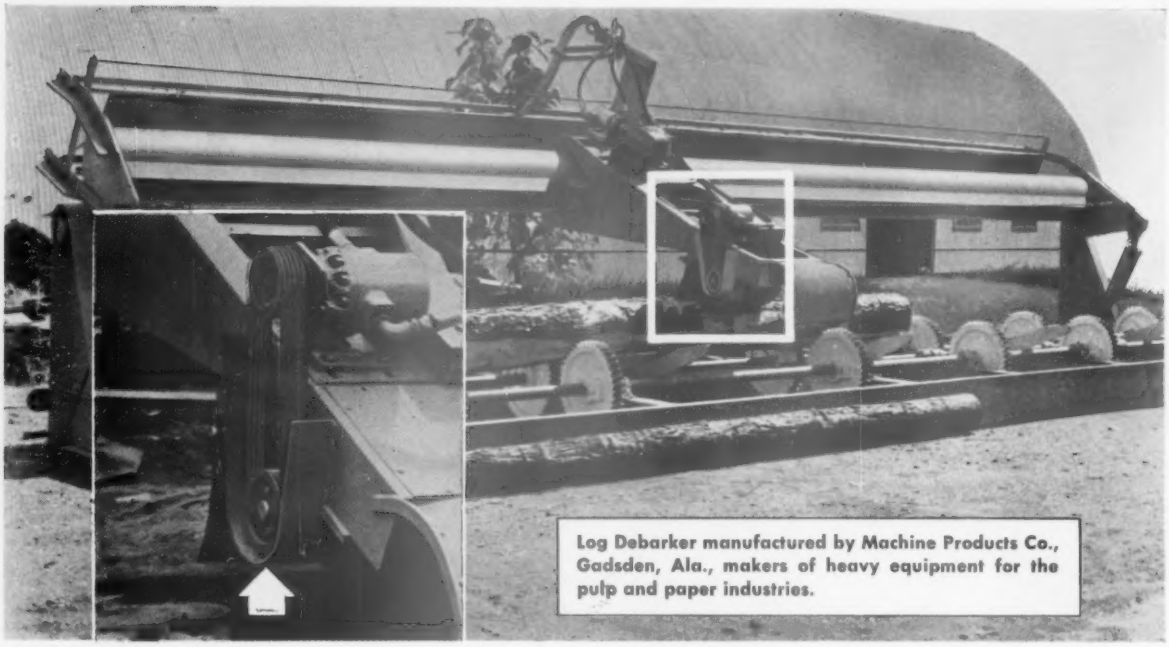
ROLO MANUFACTURING COMPANY
P. O. Box 22126, Houston 27, Texas
Canada: Petro-Automation Industries, Ltd., Edmonton and Calgary
Export: R. S. Stokvis & Sons, New York, N. Y.

Rolo



Log Debarker manufactured by Machine Products Co., Gadsden, Ala., makers of heavy equipment for the pulp and paper industries.

This V-Belt Drive costs less,

takes shock loads chain couldn't handle!

Another manufacturing problem solved by the high capacity of Gates Super HC V-Belt Drives...

The makers of the Log Debarker shown above found that the chain drive on the debarker head could not always handle the shock loads characteristic of this operation.

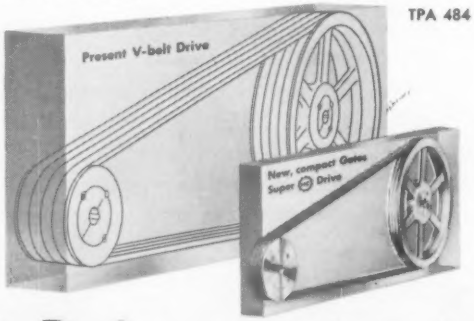
To insure buyers of this machine top performance and freedom from down time, Machine Products Company replaced the chain drive with a Gates Super HC Drive.

Not only have they eliminated down time and replacement costs from shock-load breakage of the chain, the makers have also actually cut manufacturing costs because the Super HC Drive permits a smaller debarker head.

Nation-Wide Engineering Service

A Gates Distributor or Field Representative will show you how Super HC V-Belt Drives reduce sheave diameters 30% to 50%, reduce drive space up to 50%, and drive weight 20% and more. To learn more about Gates Drive Engineering Service, ask him for a free copy of *"The Modern Way to Design Multiple V-Belt Drives"* or write the Gates Rubber Co., Sales Division, Inc., Denver, Colorado.

TPA 484



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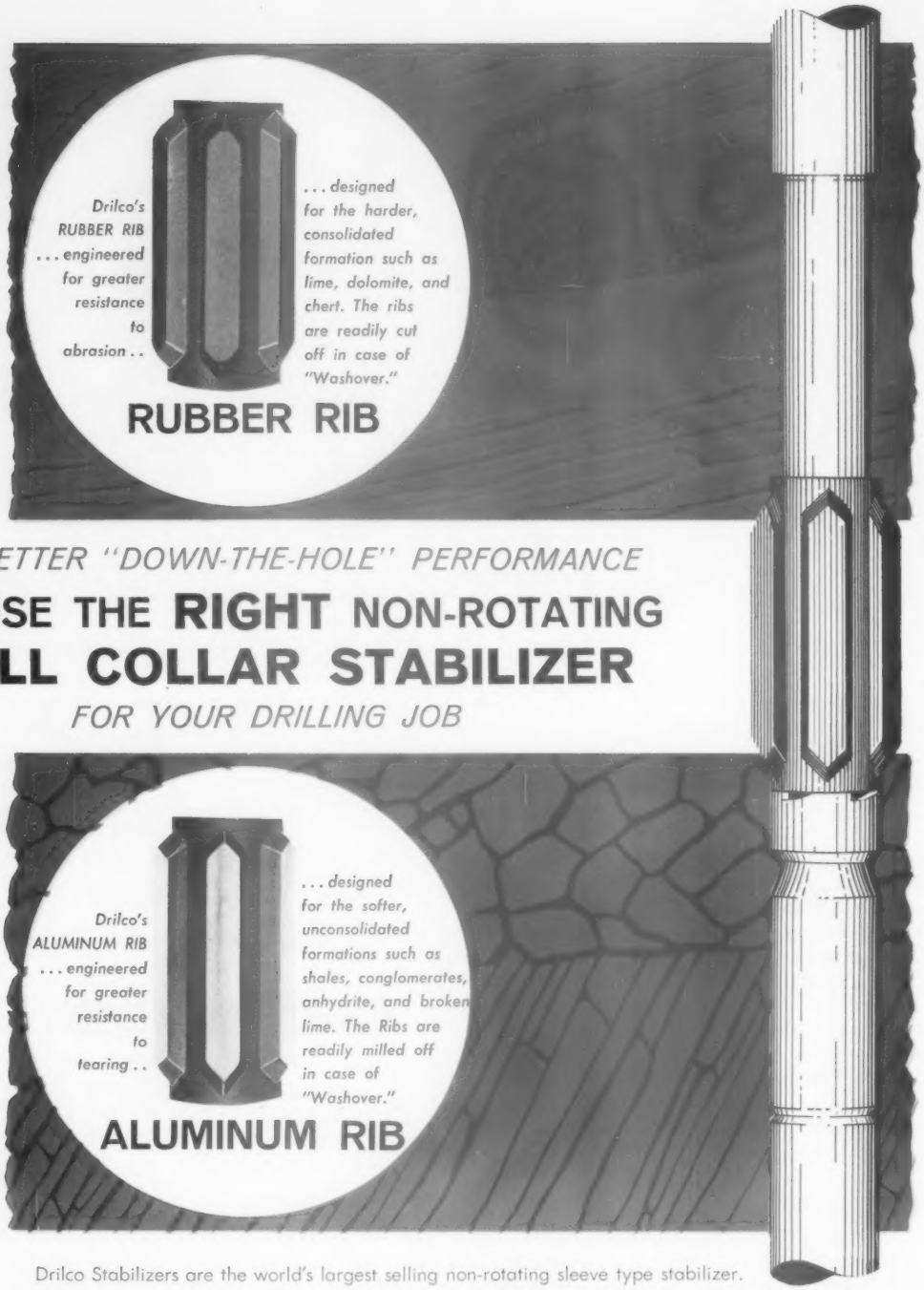
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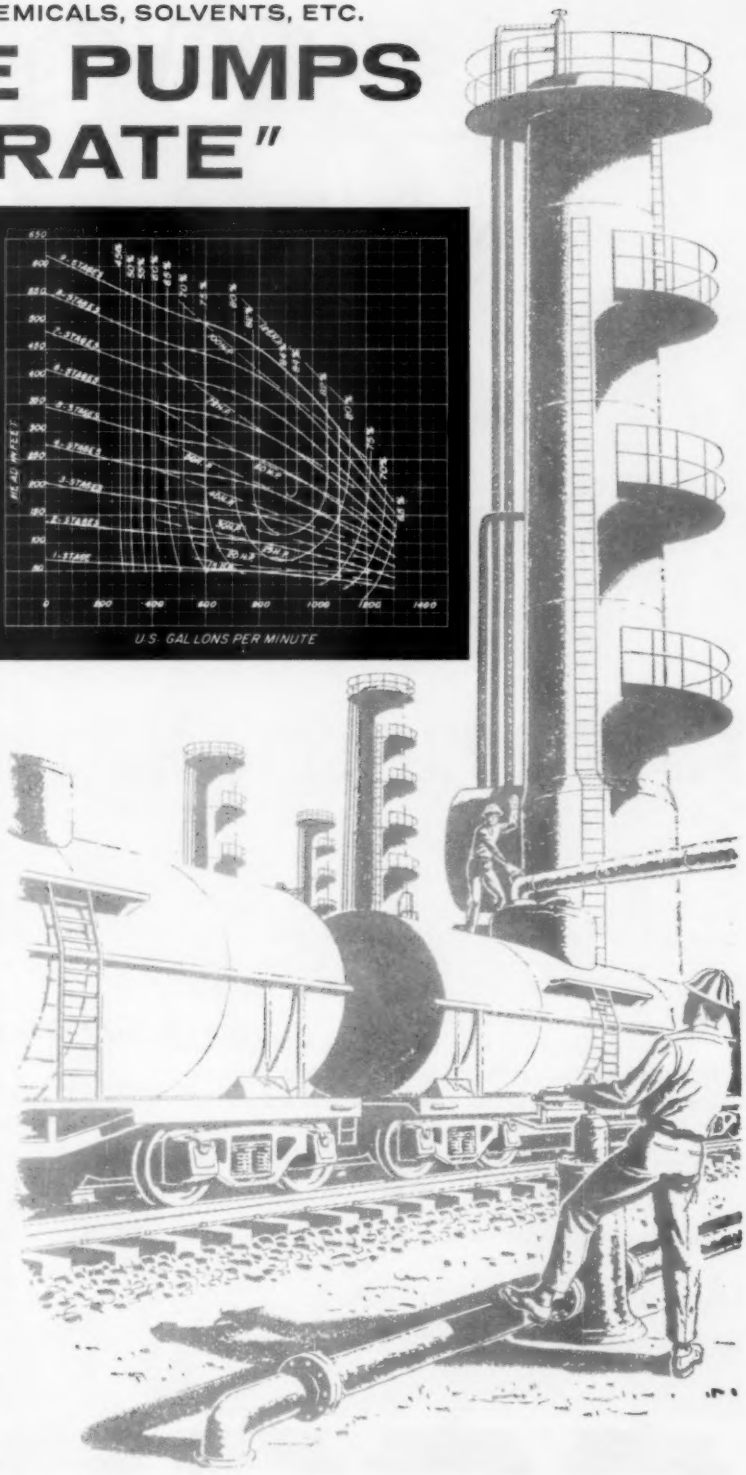
Figure 4703: Designed especially for pumping gasoline and oil from underground tanks. Capacities from 15 to 75 G.P.M. for pressures up to 100 lbs.

Figure 4700-G: For fueling systems and testing station service these pumps are usually mounted directly on steel or lined concrete storage tanks below ground. Complete range of sizes.



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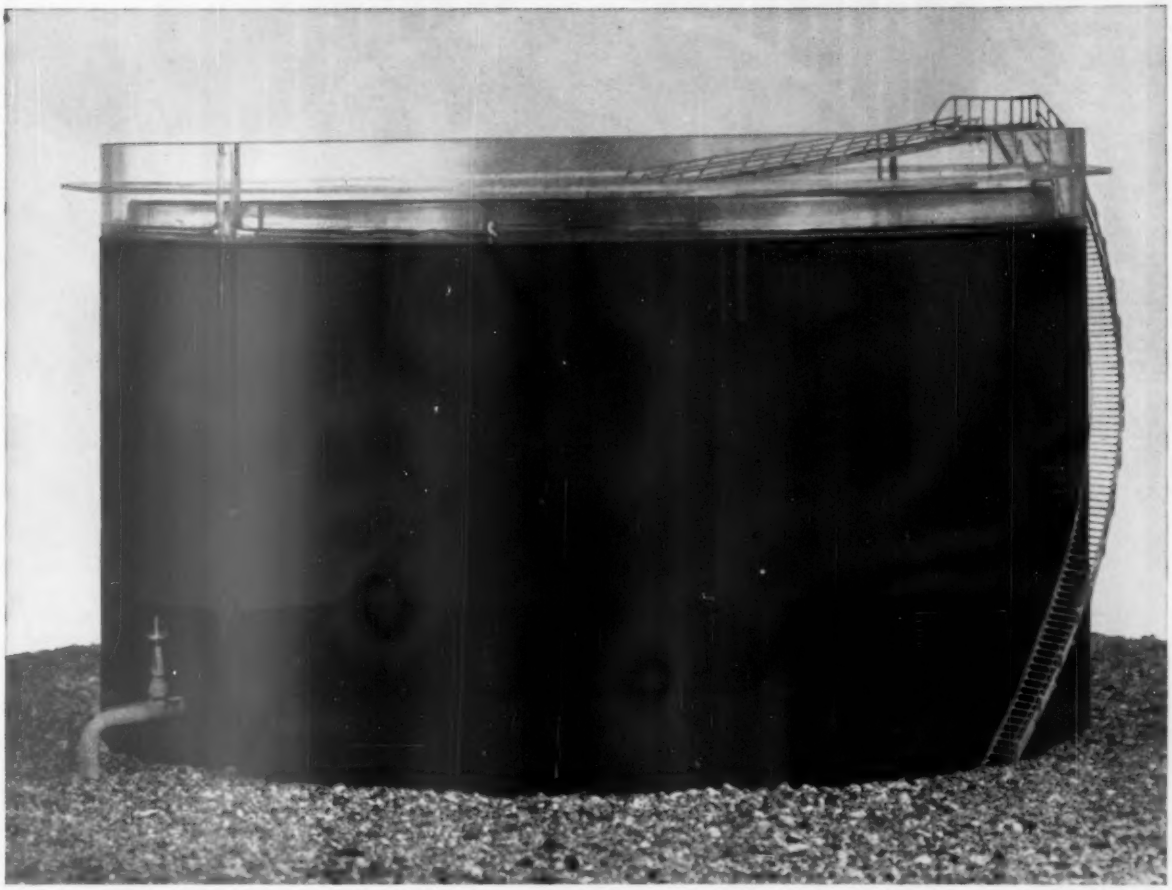
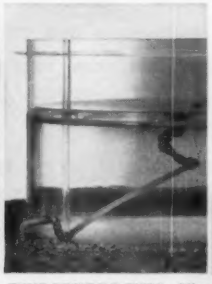


Chiksan Swivel Jointed Drain Lines team up strength + flexibility + endurance

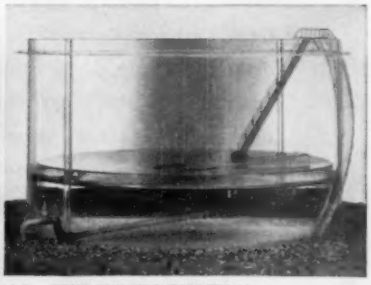
The unlimited flexibility of Chiksan swivel joint equipped floating roof drains mean money saved on every tank. First, Chiksan drains cost less than rubber hose —and, you count their useful life in years instead of months. Chiksan swivel joints and lines easily withstand tank pressures —never kink to cause drain stoppage. Both lines and joints are available in many types of metals to meet specific liquid storage requirements.

Plan now to include Chiksan drain lines in all new tank installations and in present lines that need replacement. For details, contact Chiksan or your nearby Chiksan field representative.

FULL TANK. Drain line flexes readily. Easily withstands tank pressures.



TWO THIRDS FULL. All metal line moves freely with the floating roof without danger of kinking.



TWO THIRDS EMPTY. Line folds compactly. Provides long years of trouble-free service.

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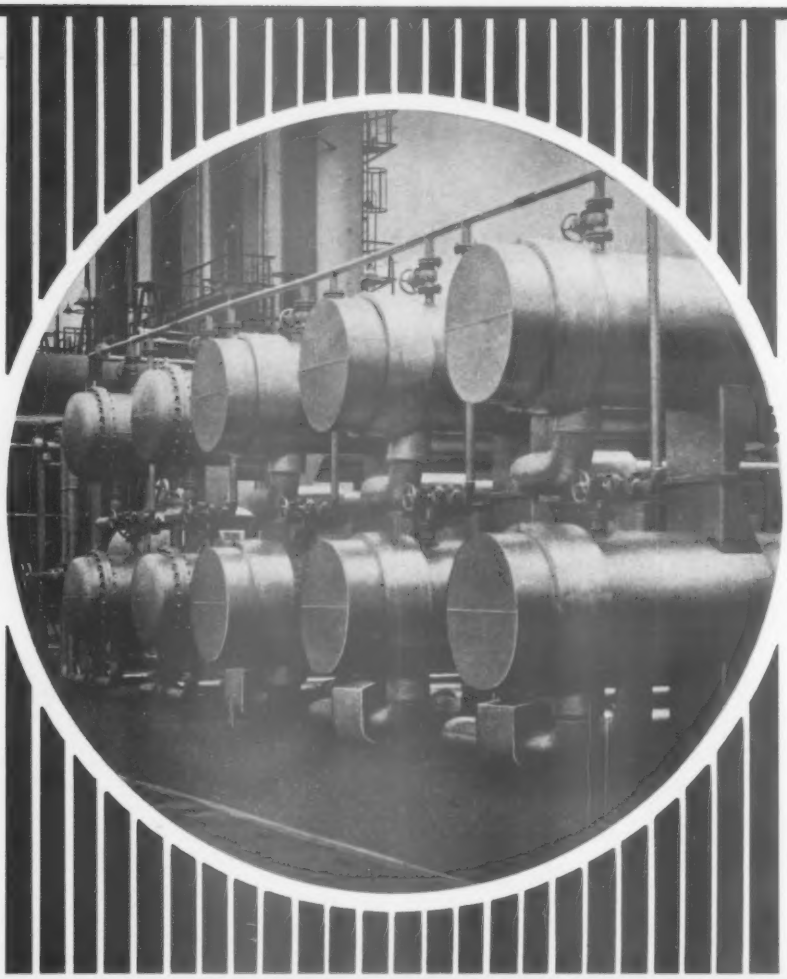

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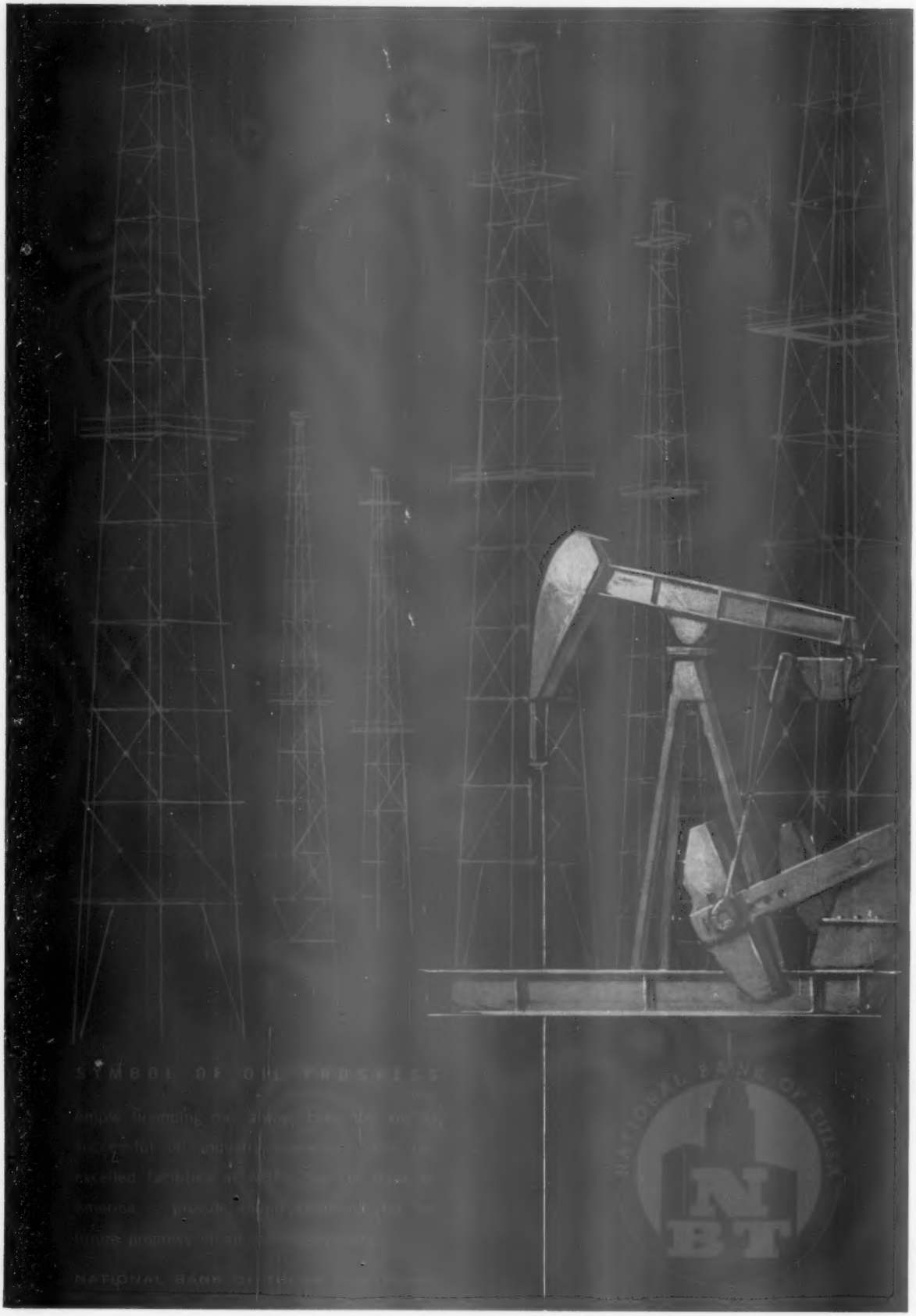
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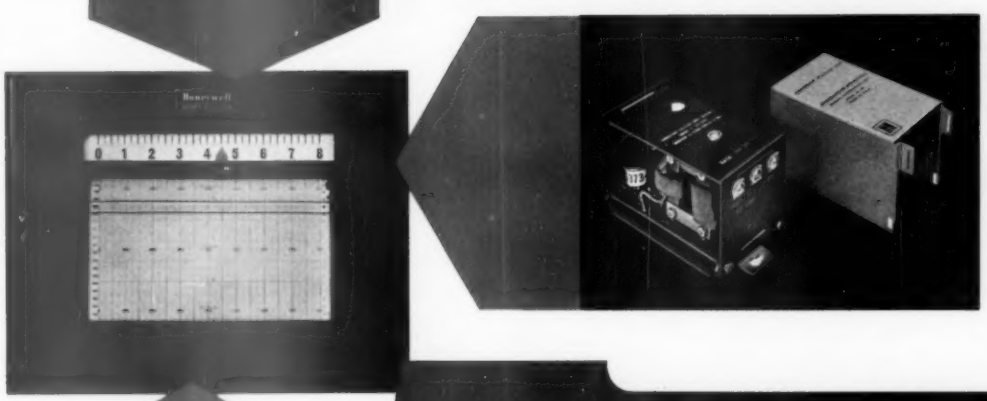
MODULAR DESIGN MAKES 1960 *Electronik* POTENTIOMETERS A GREATER VALUE THAN EVER

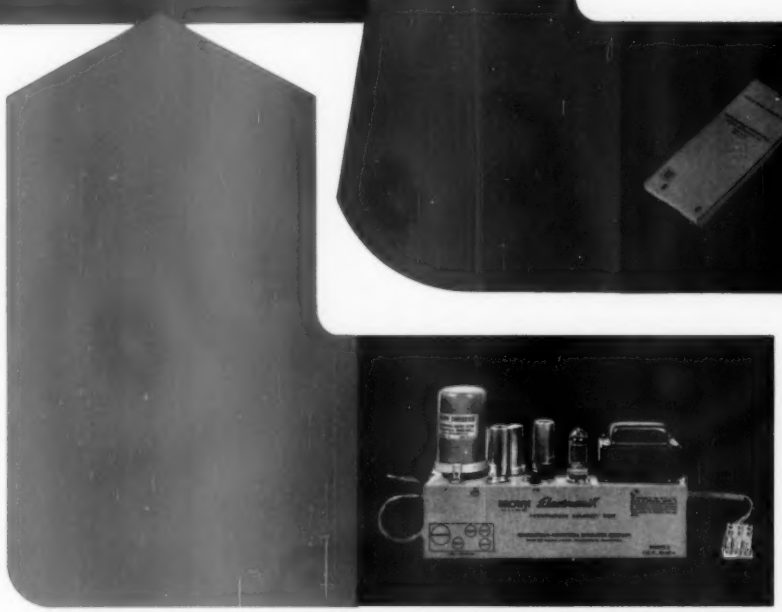
BALANCING AND CHART DRIVE MOTORS are sectionalized. Service is simplified because any major part can be replaced in a matter of seconds.



CONSTANT VOLTAGE UNIT* eliminates need for batteries, standard cells, and standardizing mechanisms . . . insuring long life.

*Zener Diode

COMPARTMENTED MEASURING CIRCUIT UNIT makes range changing easy. Change one screw on a clip connected card of fixed resistors, and the job is done in a matter of seconds.



QUICK-CONNECT AMPLIFIER is easily removed from the instrument by means of a polarized plug.

BUT THIS IS JUST PART OF THE STORY OF THE 1960 LINE OF ELECTRONIK POTENTIOMETERS.
LOOK AT THE DRASTIC CHANGES IN THE ELECTRONIK MULTI-RECORD RECORDERS.

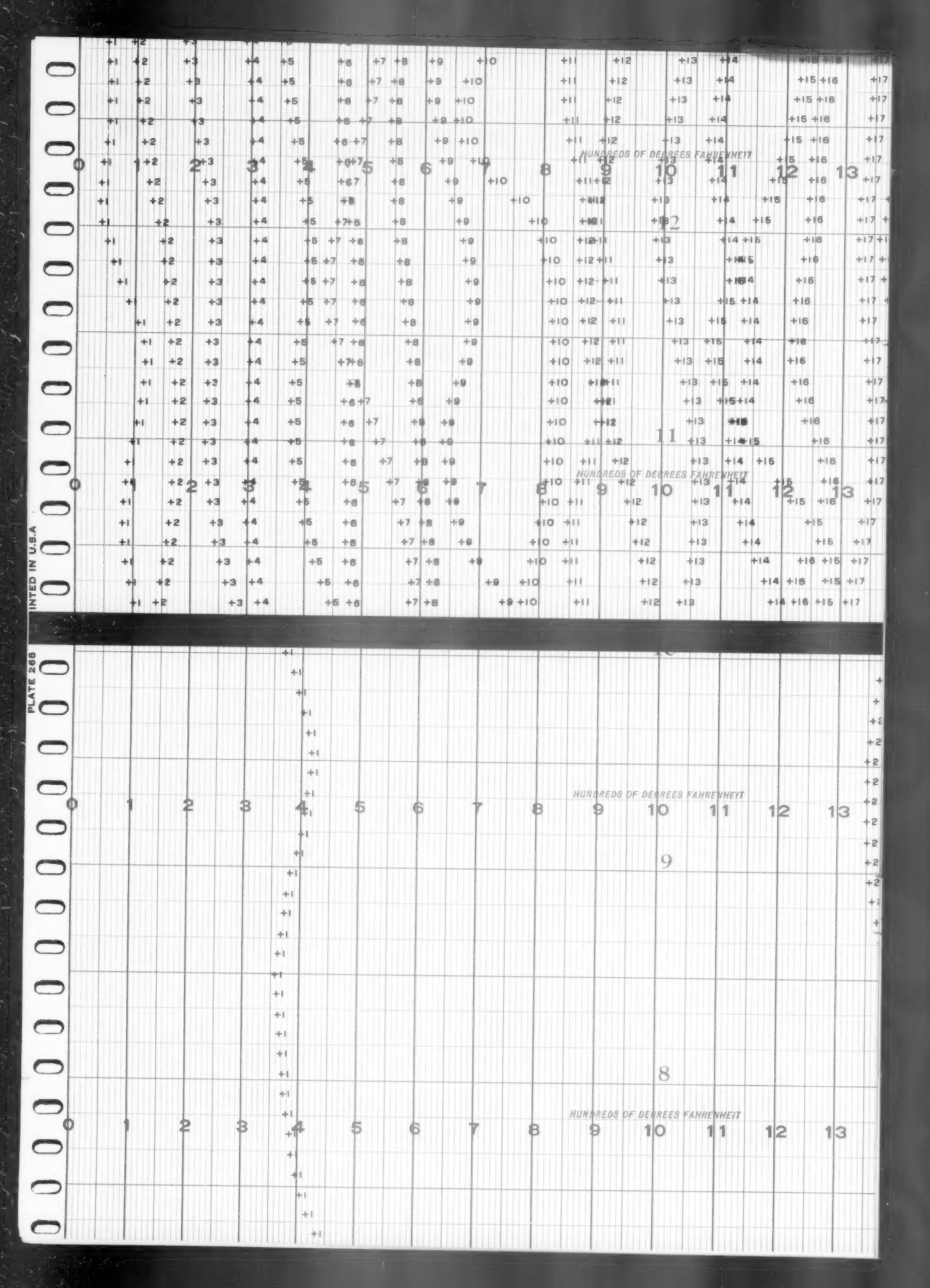

HUNDREDS OF DEGREES FAHRENHEIT
0 1 2 3 4 5 6 7 8 9 10 11 12 13
HUNDREDS OF DEGREES FAHRENHEIT
0 1 2 3 4 5 6 7 8 9 10 11 12 13
HUNDREDS OF DEGREES FAHRENHEIT
0 1 2 3 4 5 6 7 8 9 10 11 12 13
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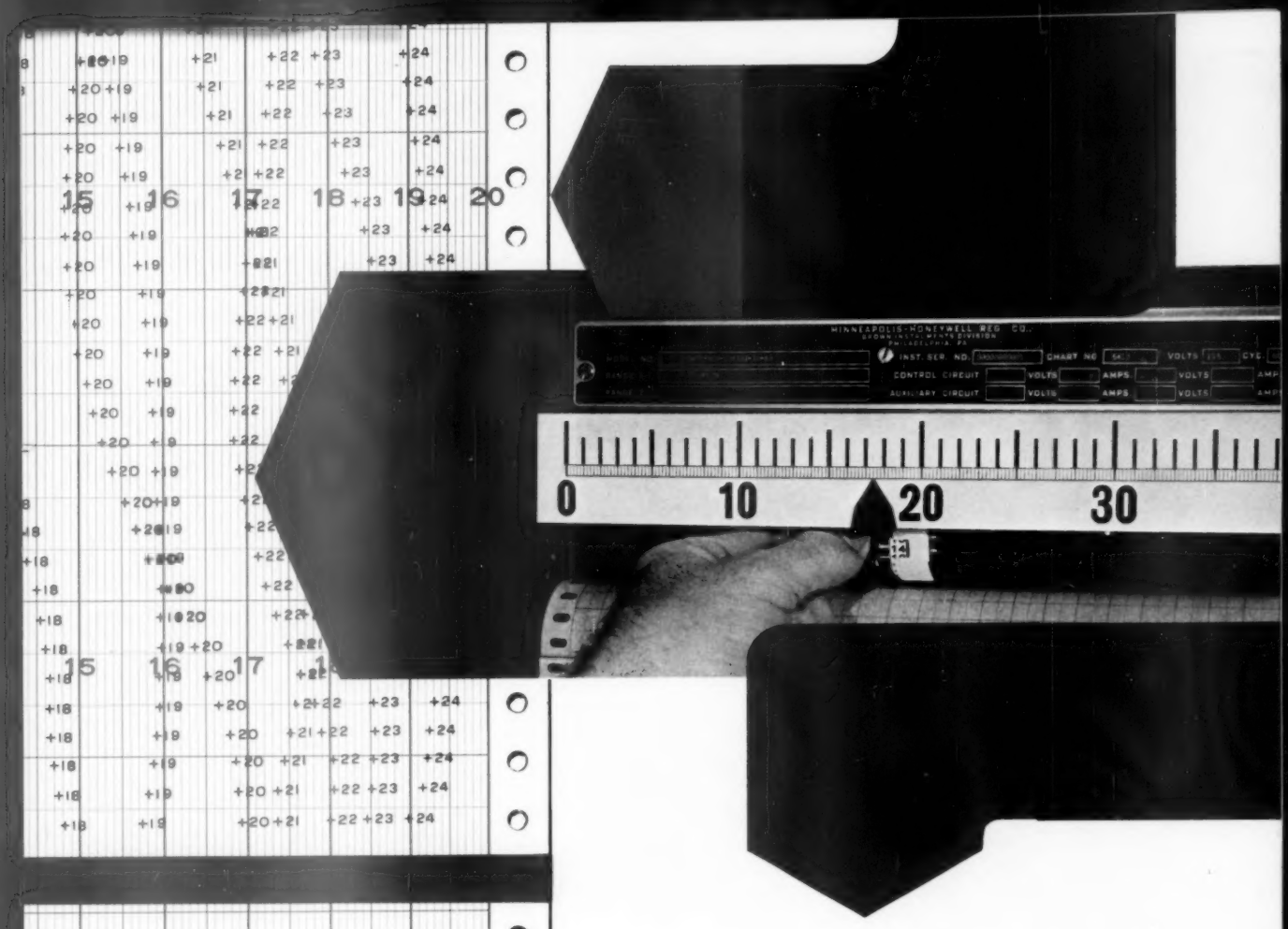
PLATE 268



Record 2 to 24 points on one instrument with new UNIVERSAL *ElectroniK*

MULTI-RECORD INSTRUMENT

Now, you can record 2,3,4,6,8,10,12,16,20, or 24 points on one ElectroniK Multi-Record Instrument . . . and change the number of points to be recorded in a matter of seconds. It's easy as this: remove a thumb-tight nut and slip off old print wheel . . . and indicator dial. Slip on a new wheel and dial: Replace nut. Plug in the number of points desired, and the job is done.

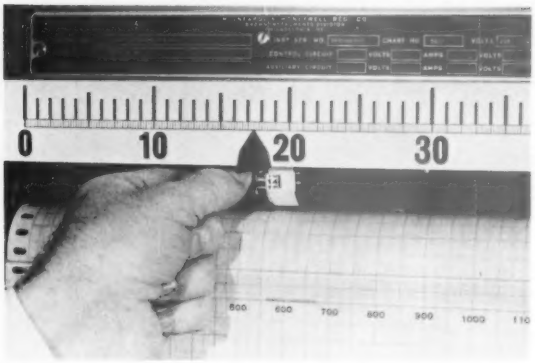
The universal features and modular design of the 1960 line of ElectroniK potentiometers are standard on all multi-record non-control models. Range and compensation changes are quick and easy, too . . . just change the cards.

FROM HONEYWELL... A DIAMOND JUBILEE PARADE OF PRODUCTS

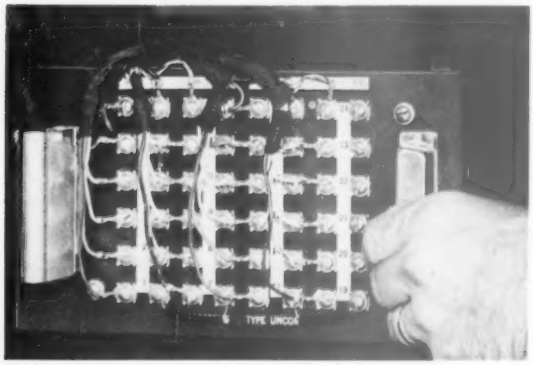
SEE HOW EASY THE 1960 ELECTRONIK MULTI-POINT RECORDERS ARE TO USE...

all it takes with the 1960 *ElectroniK* MULTI-RECORD RECORDERS to change . . .

. . . number of points recorded



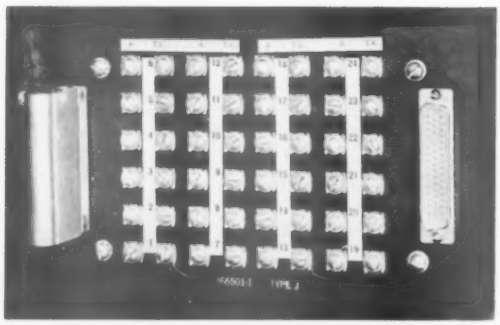
First: remove thumb-tight nut; slip off print wheel and indicator dial. Slip on new wheel and dial and replace nut.



Second: replace one plug-in unit and the instrument is ready to record a different number of points.

The new flexibility and convenience of the 1960 ElectroniK Multi-Record Recorders should interest you. This new design has resulted in substantial manufacturing cost reductions which are reflected in our new price structure. Your nearby Honeywell field engineer has the full details. He's as near as your telephone. Minneapolis-Honeywell, Wayne and Windrim Avenues, Philadelphia 44, Pa.

. . . RANGE—Loosen screws and slide out the range resistor card. Replace with a different card, tighten screws and the job is done quickly and easily.



. . . COMPENSATION—The input terminal board with built-in reference junction comes out by removing one plug. Slide in the new board, replace the screws and plug and the compensation is changed.

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First in Control

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75th YEAR

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They Say—

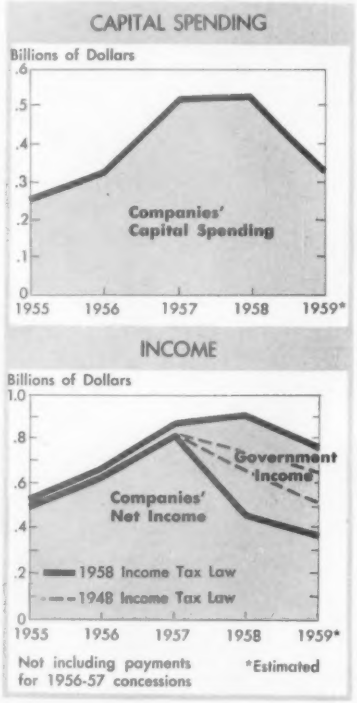
Another look at Venezuela

Dear Sir:

With reference to "Here's What Is Happening to Venezuela's Oil Industry" in your January 11 issue (p. 60), I would like to correct some figures and clarify two points not properly interpreted in your article.

The graphs on page 61 are incorrect, since both include payments for new concessions granted in 1956-57. I am enclosing corrected versions of these graphs which show the real situation.

I should like to mention that during my talk I made specific qualifications



to the figures presented, among which were the following:

1. The figures for government income from oil represent accrued taxes and not taxes collected during the year; and

2. The 1959 figure for accrued taxes was an estimate based on incomplete financial returns for the first 9 months of the year and it is certain that the final figures will be somewhat higher.

With respect to the table on capital spending, I made clear that the drop in new investment is closely related to the shut-in production, to the fact that many projects needing capital ex-

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DESIGNED FOR DRILLING FROM A FLOATING VESSEL

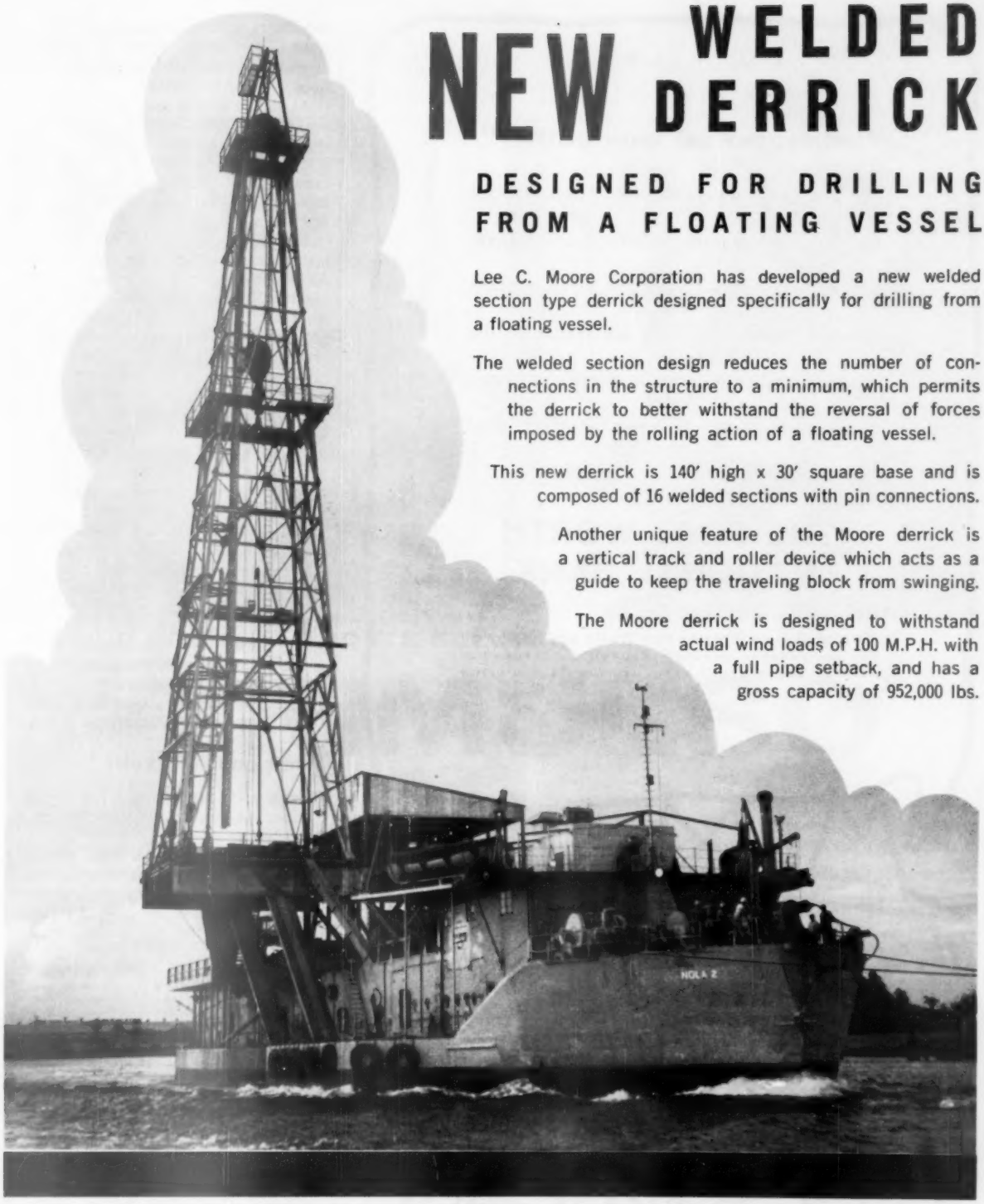
Lee C. Moore Corporation has developed a new welded section type derrick designed specifically for drilling from a floating vessel.

The welded section design reduces the number of connections in the structure to a minimum, which permits the derrick to better withstand the reversal of forces imposed by the rolling action of a floating vessel.

This new derrick is 140′ high x 30′ square base and is composed of 16 welded sections with pin connections.

Another unique feature of the Moore derrick is a vertical track and roller device which acts as a guide to keep the traveling block from swinging.

The Moore derrick is designed to withstand actual wind loads of 100 M.P.H. with a full pipe setback, and has a gross capacity of 952,000 lbs.



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P. O. BOX 216 • TULSA, OKLAHOMA • Dallas • Houston • New Orleans • Casper • Odessa • Great Bend • Pittsburgh EXPORT OFFICE: Room 624, International Bldg., 630 5th Avenue, New York 20, N. Y. • Foreign Licensed Mfr.: Oil Well Engineering Co., Ltd., Cheadle Heath, Stockport, England

"wherever oil men gather"

Oil men don't always see eye-to-eye. When it comes to exploration, drilling, pumping, refining, marketing . . . you may hear as many different theories as there are people in the room. But when it comes to financial matters, more and more, you hear this familiar phrase: For my money, it's . . .

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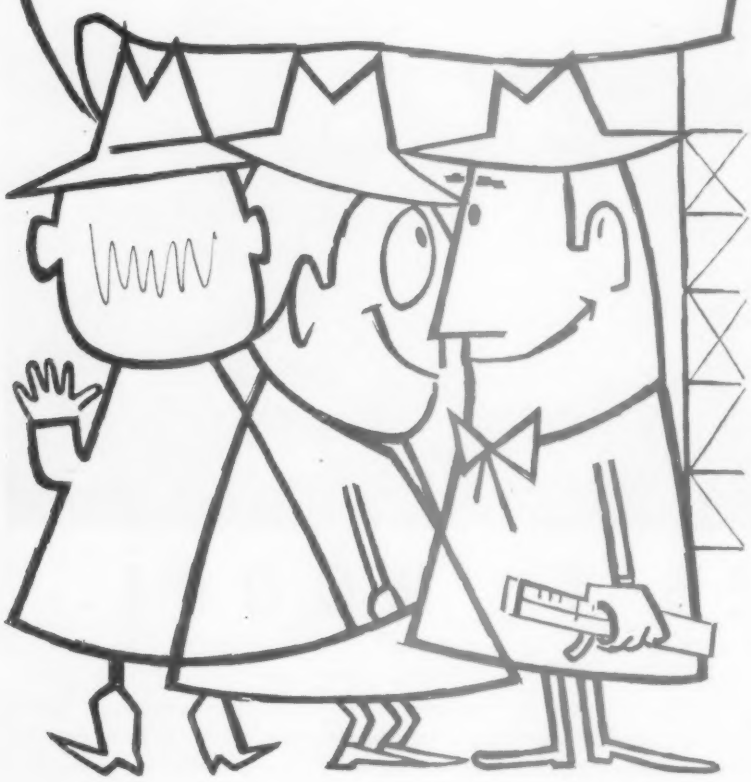
Helping Build a Greater Fort Worth and Southwest
MEMBER FEDERAL DEPOSIT INSURANCE CORPORATION
CAPITAL AND RESERVE ACCOUNTS OVER $20 MILLION



penditures were in the process of completion, and to the effect of investments on account of the new concessions granted in 1956-57.

As can be seen in the corrected version of the graph, the curve for capital spending is fairly smooth even though it still includes substantial amounts of capital for plant and equipment directly related to the activities of the newcomers.

In your article, the 1958 income tax law appears to be made responsible for the reduction in government income from oil during 1959. This is not the case. The reduction is due to two factors: first, the drop in prices for crude and products; and second, the provisions made by the operating companies to cover higher wages and salaries and improved fringe benefits that were expected to result from the collective contract negotiations which have recently been completed. These negotiations, which are the first free negotiations since 1948, were completed to the satisfaction of both the labor unions and the oil industry.

If the new tax had not been applied, estimated accrued taxes from oil in 1958 and 1959 would have been $745 and $646 millions instead of $918 and $777, respectively. The dashed lines in the graph illustrate this point.

Humberto Penaloza
Director of Economics
Venezuelan Ministry of Mines

What about Puckett?

Dear Sir:

I am an admirer of your articles, but your recent one, "Natural Gas Is Following Oil Across the Seas," (OGJ, Feb. 8, p. 155) is somewhat off. You state: "We cannot point to a single gas field over 600 billion cubic feet discovered in the U. S. in recent years."

Why don't you check into the Puckett gas field, Pecos County, Texas? Reserves are estimated at 3 trillion cubic feet of gas. And I would wager that there will be five or six gas fields of comparable size discovered within the next 5 years in the Delaware and Val Verde basins.

James A. Kurfess
Midland, Tex.

(Editor's note: Certainly OGJ is aware of the importance of Puckett field and of its great reserve. However, the field was first discovered in 1952 and use of the term "in recent years" would seem to exclude it from consideration as something really new. Also, we had in mind only those fields producing dry natural gas.)

Letters to They Say should be addressed to The Editor, The Oil and Gas Journal, Box 1260, Tulsa, Okla.

You save drilling dollars with a Baroid Mud Program

THE MUD PROBLEM AND ITS SOLUTION

TRIMULSO*

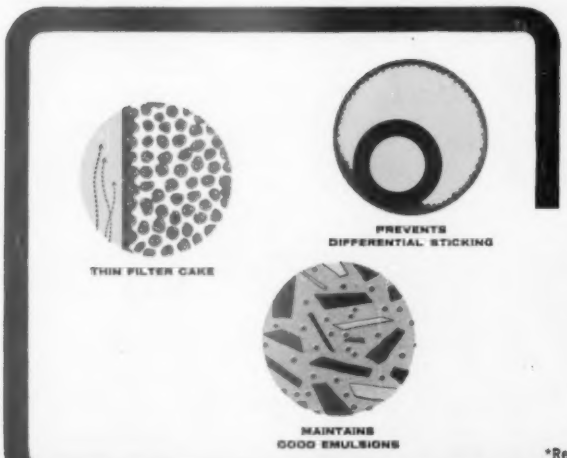
When your drilling problem is pressure differential sticking (wall sticking) TRIMULSO is your answer.

TRIMULSO was part of an over-all Baroid mud program used on a 13,685′ well in Lake Boeuf Field, Lafourche Parish, Louisiana. Baroid's experience in many areas indicated that the combination of high mud weight and uncased porous zones could cause differential sticking of the drill pipe and casing.

Previous successes in overcoming differential sticking with TRIMULSO resulted in recommending its use as a preventative on this job. TRIMULSO was added to this emulsion mud—the well was drilled to the desired depth and liner set without sticking any pipe.

TRIMULSO can also be used to advantage for other purposes such as an emulsifier and surfactant in low solids muds. TRIMULSO is effective in hard and saline waters.

A Baroid mud program is planned to give *you* drilling success and *save your drilling dollars!*



BAROID

BAROID DIVISION NATIONAL LEAD COMPANY

MAIN OFFICE: P. O. BOX 1675, HOUSTON 1, TEXAS

*Registered trademark of Baroid Division National Lead Company

6043

Quaker Thermoid FLOATER HOSE AT WORK IN FROBISHER BAY

Quaker Thermoid 600 foot continuous-length Floater Hose speeds ship-to-shore oil transfer!

Increased air traffic over the polar route has called for an immense new airfield and oil-piping system at Frobisher Bay, Baffin Island, just completed by Foundation Company of Canada Limited.

Tankers pump petroleum products through a 600-foot Thermoid-Quaker Floater Hose assembly to a 15,000-foot pipeline feeding the huge tank farm at Frobisher. An 8" Thermoid-Quaker discharge hose is floated on special inflatable Thermoid-Quaker pontoons and reeled on a power winch. This three-part rig makes up the complete Thermoid-Quaker assembly.

You do away with bulky metal drums for floating hose when you use this new Thermoid-Quaker rig. Inflatable floats take up less than a quarter of the space formerly required by floating drums. And the hose comes in such long sections that couplings are reduced by as much as 90%.

If you load or unload tankers off-shore, investigate the Thermoid-Quaker Floater Hose combinati n. Ask the Thermoid distributor, or write *Thermoid Division, H. K. Porter Company, Inc., Tacony & Comly Sts., Philadelphia 24, Pa.*

THERMOID PORTER DIVISION

H.K. PORTER COMPANY, INC.

PORTER SERVES INDUSTRY: with Rubber and Friction Products—THERMOID DIVISION; Electrical Equipment—DELTA-STAR ELECTRIC DIVISION, NATIONAL ELECTRIC DIVISION, PEERLESS ELECTRIC DIVISION; Specialty Alloys—RIVERSIDE-ALLOY METAL DIVISION; Refractories—REFRACTORIES DIVISION; Electric Furnace Steel—CONNORS STEEL DIVISION, VULCAN-KIDD STEEL DIVISION; Fabricated Products—COLDFORM DIVISION, DISSTON DIVISION, FORGE AND FITTINGS DIVISION, LESCHEN WIRE ROPE DIVISION, H. K. PORTER COMPANY de MEXICO, S. A.; and in Canada, Refractories, "Disston" Tools, "Federal" Wires and Cables, "Nepcoduct" Systems—H. K. PORTER COMPANY (CANADA) LTD.

CALENDAR

MARCH

21-22 Midwest Gas Association, annual meeting, Hotel St. Paul, St. Paul.

21 University of Texas, school of gas technology, sixth semi-annual term, Kilgore College, Kilgore. Term ends April 29.

23 Petroleum Equipment Suppliers Association, Pacific district annual membership meeting, Ambassador Hotel, Los Angeles.

24-25 New England Gas Association, annual meeting, Hotel Statler-Hilton, Boston.

25-26 North Texas Oil and Gas Association, thirtieth annual meeting, Kemp Hotel, Wichita Falls, Tex.

28 University of Texas, American Petroleum Institute Division of Transportation, school of pipeline technology, eighth semi-annual term, Lee College, Baytown, Tex. Term ends May 6.

28 University of Texas, American Petroleum Institute Division of Production, institute on automatic production controls, first term, Odessa College, Odessa, Tex. Term ends May 6.

28 Independent Oil Producers and Land Owners Association, Tri-State, annual meeting, Hotel McCurdy, Evansville, Ind.

29 Petroleum Equipment Suppliers Association, Gulf Coast district membership meeting, Shamrock Hilton Hotel, Houston.

28-30 Western Petroleum Refiners Association forty-eighth annual meeting, Hilton Hotel, San Antonio, Tex.

29-31 American Power Conference, annual meeting, Sherman Hotel, Chicago.

30-Apr. 1 American Petroleum Institute, Division of Production, Mid-Continent district meeting, Broadview Hotel, Wichita.

APRIL

3-5 Society of Exploration Geophysicists, annual midwestern regional meeting, Washington-Youree and Captain Shreve hotels, Shreveport, La.

3-8 Engineers Joint Council, sixth nuclear congress, New York.

4-6 American Institute of Electrical Engineers, southwest district meeting, Shamrock-Hilton Hotel, Houston.

4-7 Oil Heat Institute of America, annual convention, Park-Sheraton Hotel, New York.

4-7 National oil heat and air-conditioning exposition, Coliseum, New York.

4-8 Society of Automotive Engineers, national aeronautic meeting, Commodore Hotel, New York.

5 Petroleum Equipment Suppliers Association, southern mid-continent district membership meeting, Statler Hilton Hotel, Dallas.

5-6 University of Kansas, eighth annual gas compressor institute, National Guard Armory, Liberal, Kans.

5-7 Instrument Society of America, national chemical and petroleum instrumentation symposium, Rochester, N. Y.

7-8 Rocky Mountain Oil and Gas Association, midyear meeting, Newhouse Hotel, Salt Lake City.

8 Chemical Institute of Canada, rubber chemistry division, annual meeting, Kitchener, Ont.

12-14 Petroleum Industry Electrical Association, Petroleum Electric Supply Association, conference and exhibi-

GET THE MOST

Mission SUPER-SERVICE®

Mission MUD MONARCH®

Mission SILVER TOP®

ONE OF THESE MISSION VALVES AND SEATS WILL GIVE YOU THE MOST FOR YOUR MONEY

Because Mission Valves and Seats are designed to give you the most for your particular service. For *extremely high pressures*, the Mud Monarch® with an effective seal ring even when body and seats are severely worn. Compound 308® and Compound 711 inserts are available. For *medium pump pressures*, the Mission Super Service, with four cross arms for extra strength. And for *low and medium pressures*, the Silver Top with replaceable, wear-taking bushing which greatly reduces valve seat replacement. Compound 308 inserts are interchangeable with Super Service valves. Longer life is built in to all Mission valves and seats to give the most with all popular makes of reciprocating pumps. At supply stores everywhere.

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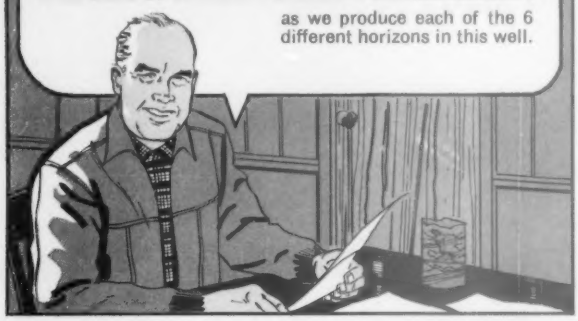
1

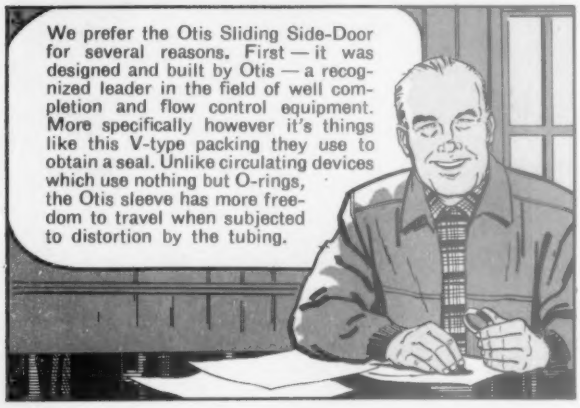
OTIS SLIDING SIDE-DOOR EQUIPMENT

WILL SAVE US SEVERAL HUNDRED DOLLARS PER ZONE

as we produce each of the 6 different horizons in this well.

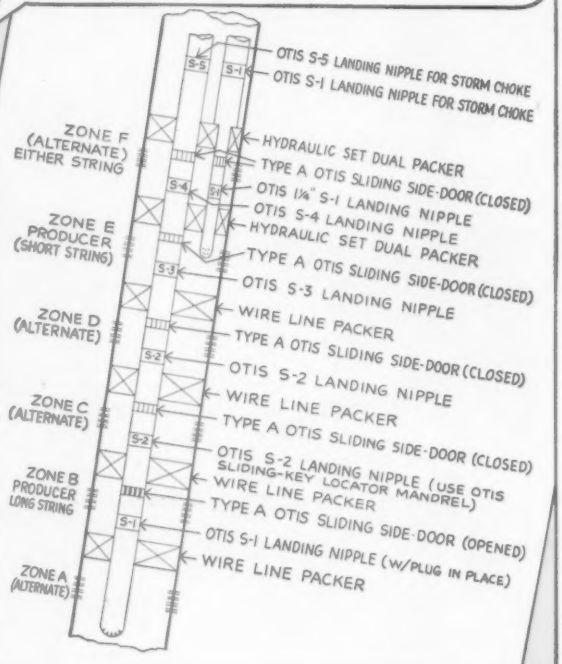


We prefer the Otis Sliding Side-Door for several reasons. First — it was designed and built by Otis — a recognized leader in the field of well completion and flow control equipment. More specifically however it's things like this V-type packing they use to obtain a seal. Unlike circulating devices which use nothing but O-rings, the Otis sleeve has more freedom to travel when subjected to distortion by the tubing.



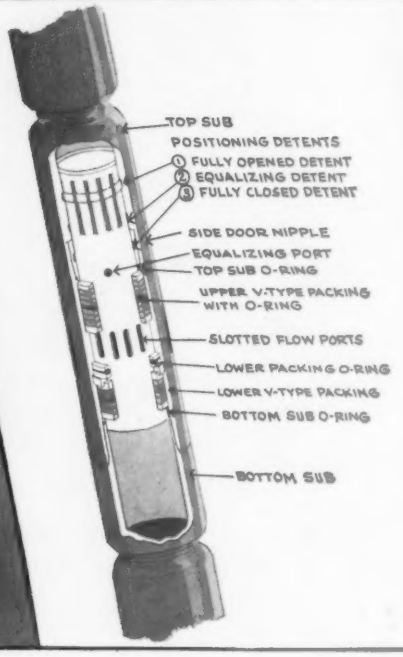
2

Add to that the thousands of dollars we saved by drilling only one well to produce these 6 formations and you'll see why we're sold on multiple-zone wells and Otis Sliding Side-Door Equipment. Here's a diagram of the well.


OTIS S-5 LANDING NIPPLE FOR STORM CHOKE
OTIS S-1 LANDING NIPPLE FOR STORM CHOKE
ZONE F (ALTERNATE) EITHER STRING
HYDRAULIC SET DUAL PACKER
TYPE A OTIS SLIDING SIDE-DOOR (CLOSED)
OTIS 1¼" S-1 LANDING NIPPLE
ZONE E PRODUCER (SHORT STRING)
OTIS S-4 LANDING NIPPLE
HYDRAULIC SET DUAL PACKER
TYPE A OTIS SLIDING SIDE-DOOR (CLOSED)
OTIS S-3 LANDING NIPPLE
ZONE D (ALTERNATE)
WIRE LINE PACKER
TYPE A OTIS SLIDING SIDE-DOOR (CLOSED)
OTIS S-2 LANDING NIPPLE
ZONE C (ALTERNATE)
WIRE LINE PACKER
TYPE A OTIS SLIDING SIDE-DOOR (CLOSED)
OTIS S-2 LANDING NIPPLE (USE OTIS SLIDING-KEY LOCATOR MANDREL)
ZONE B PRODUCER LONG STRING
WIRE LINE PACKER
TYPE A OTIS SLIDING SIDE-DOOR (OPENED)
OTIS S-1 LANDING NIPPLE (W/PLUG IN PLACE)
ZONE A (ALTERNATE)
WIRE LINE PACKER

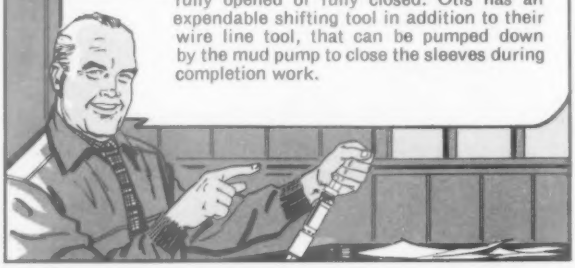
3

Then there's Otis' vertical slotted port design. This gives Otis Sliding Side-Doors maximum strength — and acts to prevent distortion of the tools as they are subjected to the stress and torque of a production string. Models with special pump-out plugs are also available to let you test your packer before nippling up the tree. Check the design advantages in this drawing.



5

Another advantage of this Otis equipment is that with their shifting tool they can open and/or close one or several sleeves with just one trip of the wire line. And you're sure the sleeves are fully shifted, too. Otis' shifting tools won't release until the sleeves are either fully opened or fully closed. Otis has an expendable shifting tool in addition to their wire line tool, that can be pumped down by the mud pump to close the sleeves during completion work.



6

We've tried other circulating valves and "substitute" tools, but found we didn't have the versatility needed. Consequently, we use Otis Sliding Side-Doors. This gets back to Otis' being specialists in completion and production problems, and their knowing the type of equipment required. If you need circulating tools — call Otis and get the best. If you need help with a well completion — again, call Otis and get the best.

OTIS

OTIS ENGINEERING CORPORATION

General Offices: 6612 Denton Drive · Dallas

Branches Throughout the Oil Country

tion, Municipal Auditorium, Kansas City.

15-16 Society of Economic Paleontologists and Mineralogists, Permian Basin section, annual meeting, technical session and field trip, Windsor Hotel, Abilene, Tex.

15-16 Society of Economic Paleontologists and Mineralogists, Pacific section, annual spring field trip, Panoche Hills, San Joaquin Valley, California, and evening meeting, The Hacienda, Fresno, Calif.

19-21 University of Oklahoma, College of Engineering, southwestern gas measurement short course, north campus, University of Oklahoma, Norman.

19-21 American Society of Lubrication Engineers, annual meeting and lubrication exhibit, Netherland Hilton Hotel, Cincinnati.

20 Chemical Institute of Canada, joint meeting, Quebec rubber and plastics group and Montreal section, Queen's Hotel, Montreal.

20-22 American Petroleum Institute, Division of Production, Rocky Mountain district meeting, Gladstone, Henning, and Townsend hotels, Casper, Wyo.

20-22 National Petroleum Association, semiannual meeting, Hotel Cleveland, Cleveland.

21-22 Oklahoma State University, technical conference on heat transfer, Stillwater, Okla.

21-22 Texas Technological College, seventh annual West Texas oil lifting short course, Lubbock, Tex.

24-26 Independent Petroleum Association of America, midyear meeting, Denver Hilton Hotel, Denver.

25-26 American Society of Mechanical Engineers, maintenance and plant engineering conference, Chase-Park Plaza Hotel, St. Louis.

25-27 Southern Gas Association, convention, Buccaneer and Galvez hotels, Galveston.

25-28 American Association of Petroleum Geologists, Society of Economic Paleontologists and Mineralogists annual meeting, Chalfonte-Haddon Hall, Atlantic City, N. J.

25-29 American Welding Society, annual meeting and welding exposition, Los Angeles.

27-29 Natural Gasoline Association of America, annual convention, Rice Hotel, Houston.

28-29 American Petroleum Institute, Division of Transportation, pipeline conference, Mayo Hotel, Tulsa.

28-29 Pacific Coast Gas Association, distribution conference, Benson Hotel, Portland.

MAY

1-3 Texas Independent Producers and Royalty Owners Association, fourteenth annual membership meeting, Holiday Inn, Carlton and Blackstone Hotels, Tyler, Tex.

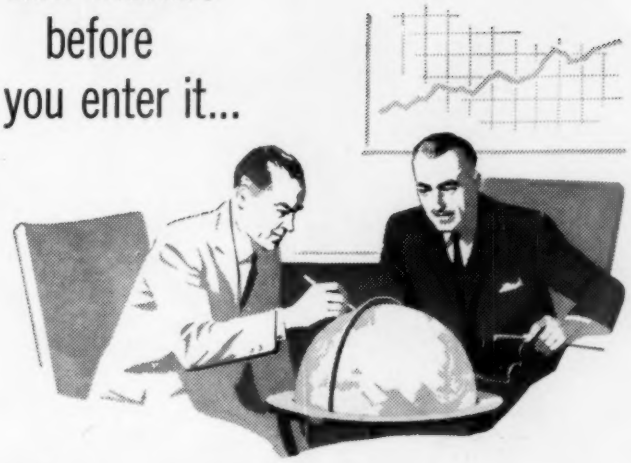
1-4 American Petroleum Institute, Division of Transportation, tanker conference, Seaview Country Club, Absecon, N. J.

2-3 Society of Petroleum Engineers of AIME, North Texas section, fourth biennial secondary recovery symposium, Wichita Falls, Tex.

5-6 American Institute of Mining, Metallurgical and Petroleum Engineers, annual joint meeting of Rocky Mountain petroleum sections, Calgary.

5-6 Canadian Institute of Mining and Metallurgy, annual technical meeting of petroleum and natural gas division, Palliser Hotel, Calgary.

you survey
a new market
before
you enter it...



...why not survey
this Banking connection
in oil-rich Canada?

Interested in Canadian oil and natural gas? The *right* banking connection can be invaluable. That's the kind of connection you can make with The Toronto-Dominion Bank.

Toronto-Dominion specializes in banking for the oil and gas —and related—industries. Our experienced Oil & Gas Department in Calgary is in close and constant touch with the industry. It can furnish you the facts and figures you need—can advise you on new trends and developments, credit standings, equipment distributors.

Our more than 550 branches from coast to coast include locations at all the major oil and gas fields. They put "The Bank" in a unique position to give you on-the-spot banking help and related assistance.

Investigate for yourself our complete banking services. You can start by sending for our map showing Western Canada oil and gas fields—plus Toronto-Dominion branches in the area.

THE

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Oil and Gas Department
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"...pacing the pipeline construction industry
for more than a quarter century"

price tower

PIPELINE
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CONSTRUCTORS

bartlesville, oklahoma

the Journal said...

50 years ago

March 20, 1910

Advances posted this week in Oklahoma crude-oil prices are creating a better feeling among producers than at any time since Glenn Pool flooded the market. The Texas Co. and Gulf Pipe Line Co. boosted postings 3 cents from 33 to 36 cents. Prairie Oil & Gas Co. went up 3 cents from 35 to 38 cents on crude 30°-gravity and above, and 2 cents to 30 cents on crude below 30° gravity.

Five of the eleven stills being provided at Standard Oil Co. of Louisiana's nearly completed Baton Rouge refinery go on stream for the first time. Initial runs are being supplied by Oklahoma crude shipped in by tank car pending completion within 60 days of Standard Pipe Line Co.'s new pipeline. When all 11 stills are completed, the refinery will have a crude capacity of 15,000 bbl. daily.

25 years ago

March 21, 1935

First lightweight portable rotary rig using constant-torque prime movers starts drilling for Gypsy Oil Co. (Gulf) at Eunice, N. M. Previously, large size and high cost of needed speed-reducing and reverse gears limited application of gasoline, diesel, or electric power to larger and heavier rigs.

Seamen's strike paralyzes California oil industry. Coastwise movement of crude and refined products halts. Jammed terminals and crowded storage soon may force shutdown of field production.

Kansas' daily average oil production for the week jumps 6,116 bbl. to all-time high of 149,741 bbl. Busy Burrton field, in Harvey County, permitted to go above 25,000 bbl. daily for first time to daily average output of 25,125 bbl. It becomes state's top field.

10 years ago

March 23, 1950

Bitter storm of protest arises over Texas Railroad Commission's junking of MER formula for oil proration in favor of one based on acreage and depth. Heavily cut flush areas charge discrimination. Some large refiners claim they can't get right types of crude.

Texas Eastern Transmission Corp. contracts for delivery up to 250 M.M.c.f. of gas daily to Algonquin Gas Transmission Co. for resale to utilities in New England area. Algonquin plans construction of pipeline system from gas-delivery point at Lambertville, N. J., on Texas Eastern's Big Inch system.

JOURNALLY SPEAKING

Mexican Report-Yankee Style

THINGS have been hectic enough around this shop, without the editor taking off on a junket to Mexico. But he did. And he came back to wintry Tulsa 10 days later sporting a sunburn which was regarded with something less than rapt admiration by the rest of the staff.

The party of nine U. S. trade-journal editors saw a lot of Mexico's booming oil industry as guests of its sole proprietor, Petroleos Mexicanos. We were frankly impressed with what we saw. There's a lot going on south of our border. Refineries are building, new rigs are drilling, pipelines are being laid, and petrochemical plants are going up, from Reynosa to the Isthmus.

In fact we felt quite at home among familiar equipment names and a stir of business that had a distinct Yankee flavor to it. Whatever our private feelings might be on government-owned industries, we had to admit that we were witnessing a lot of busy people in action.

Pemex may have some of those professional bureaucrats which we must admit to in our country. But if so, they were kept well out of sight. We saw a Mexico quite different from the "Turista's" concept.

What impressed us most of all were the young engineers we met. With exception of two of our Spanish-speaking colleagues, we talked with them in English—to our embarrassment. They came from varied backgrounds, from the small towns and the large cities of Mexico. On their way, they studied at campuses around the world: Mexico, England, Texas, France, Oklahoma, and Italy.

But one thing these young men have in common. They know what they are doing, and they seem to be having a ball doing it. It appeared to us that they are the great strength of Pemex, whose motto is "Al Servicio de la Patria."

They were evident in all of the refining centers and producing areas we visited—Tampico, Poza Rica, Mexico City, Salamanca, Reynosa, and Ciudad Pemex.

But the visit wasn't a solid diet of oil. Bad weather kept us from flying over to the Gulf Coast for several days. So, we were obliged to spend one day in Acapulco inspecting, uh, marketing facilities.

Then, too, we saw a steel plant, and a pipe mill which was turning out bigger pipe for larger gas lines to deliver more gas to steel mills to produce more steel, etc. This is the gist of what's happening in that country. And Pemex is right in the middle of things.

We had a taste of contrast, too. One day, returning to Poza Rica from San Andres field, we turned off the road. Around the first bend loomed a massive pyramid—a 3,000-year-old monument to Mexico's past glory. We were told that descendants of the people who built this pyramid and 180 other structures in the area, still live nearby.

We were awed by the enormous cost of erecting this ancient city, with only the muscles of men. Those few remaining people of this pre-Mayan race will one day command far greater potential for getting things done, in the form of diesel fuel and gasoline, as Mexico progresses up the ladder of energy utilization.

Right here, we'd like to haul off and say something nice about competitors—our competitors who made this Mexican visit with us. They are a very fine bunch of Joes and we thoroughly enjoyed their company.

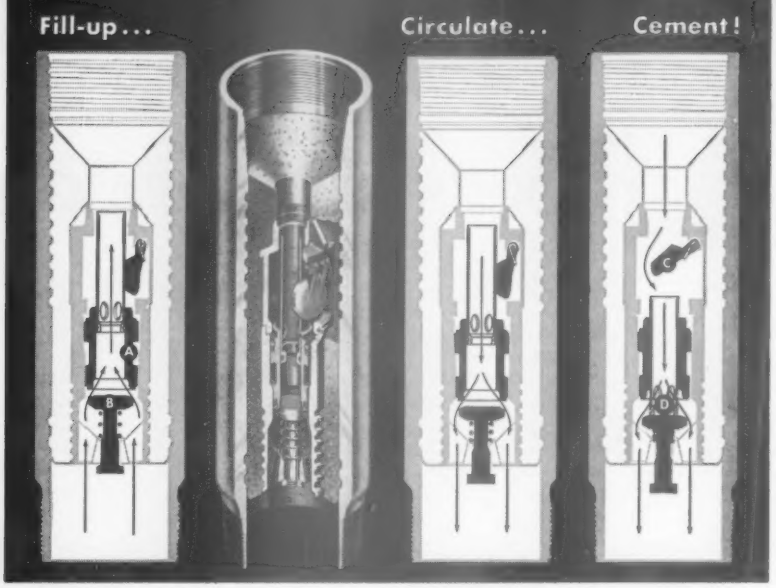
We learned quite a lot from Pemex. Perhaps Pemex people learned something from us, too. That is, that competition is a great spur to getting things done. As a monopoly, Pemex doesn't have this advantage. They're doing it the hard way.

In the form of eight other editors breathing down his neck, competition got even this editor down to his typewriter and to work. The result is a general report on Mexico a few pages farther along in this issue. You may already have read some accounts on this subject in the daily oil press. Soon you'll find further details on what Pemex is up to in several monthly publications devoted to specific divisions of this industry.

These accounts will be as objective and as factual as we know how to make them, because every one of us is competing to outdo the other. That's competition, the brisk, clean kind. It promotes just one thing—a better product for the consumer.

And that's you.

—George Weber



Ⓐ **Valve Sleeve**

Ⓑ **Valve Seat**

Fig. 1 Running in. Variable Valve opens at slightest pressure build-up, and permits unrestricted fluid entry.

Baker Circulating Differential Fill-Up Collar, Product No. 109-E M&F

Fig. 2 Valve open for circulating and hole conditioning.

Ⓒ **Flapper Valve**

Ⓓ **Tripping Ball**

Fig. 3 Before cementing, the flapper valve is placed in operation by dropping a tripping ball and applying pump pressure.

NOW you can Circulate with Baker Differential Equipment

New Circulating Differential Equipment permits circulation at any time while running casing and still retains all the important features of regular Baker Differential Equipment.

The variable valve in Baker CIRCULATING DIFFERENTIAL shoes and collars is activated *instantly* by the *slightest* increase in differential pressure. Filling is practically as free as though open-end casing were being lowered, thus preventing the build-up of *any* destructive pressure surges. The rate of fill is *always* in complete balance with the rate of lowering and there is no danger of overfill because the differential valve automatically maintains the fill at a level below the fluid level in the well.

You get relief from pressure surges at the *bottom of the string* where pressure build-up occurs. There are no spring-loaded valves to be forced open during the filling operation—no restricted fluid entry through undersized side ports, ineffectively located a joint or two up the string.

Baker CIRCULATING Differential Equipment, with its integral back-pressure valve can be run in tandem, but cannot be used with floating equipment. Circulating Collars can be run with inexpensive Baker Guide Shoes. The CIRCULATING Shoe can be run with or without a Baker Baffle Collar for stopping the cementing plug.

Baker CIRCULATING Differential Shoes and Collars cost no more than Differential Equipment without the "circulating" feature.

Ask for your copy of this brochure which contains facts you should know about Baker DIFFERENTIAL Shoes and Collars; and Supplement No. CS-342-A on the new CIRCULATING Differential Equipment.

BAKER OIL TOOLS, INC. • HOUSTON • LOS ANGELES • NEW YORK

Oil needs to think in a new direction

PSYCHIATRISTS are familiar with a form of mental illness in which the patient is suddenly confronted with a whole new set of conditions and cause-and-effect relationships, and is unable to adjust to the change.

The frustration and bewilderment cause a paralysis of the thinking process, and the patient is unable to make even the simplest decisions.

Something akin to that form of neurosis seems to be contributing to the oil industry's current troubles.

FOR NEARLY A CENTURY oil enjoyed a rapidly expanding market. At times demand grew so fast that the industry was hard pressed to increase supply to keep pace.

Now the rate of growth has slacked off drastically, but the industry hasn't changed its patterns of thought and action. It seems bewildered. In times of shortage it did well and met all its obligations. In time of plenty it doesn't know what to do about anything.

The concept of continuous economic growth is so deeply rooted that it lulled the oil industry into assuming that rapidly expanding demand is an indisputable fact of life. But now oil can't crowd other fuels out of the market much more. In fact, other fuels are taking some of oil's market.

So for the next few years, at least, oil demand probably will increase no faster than the growth of the general economy.

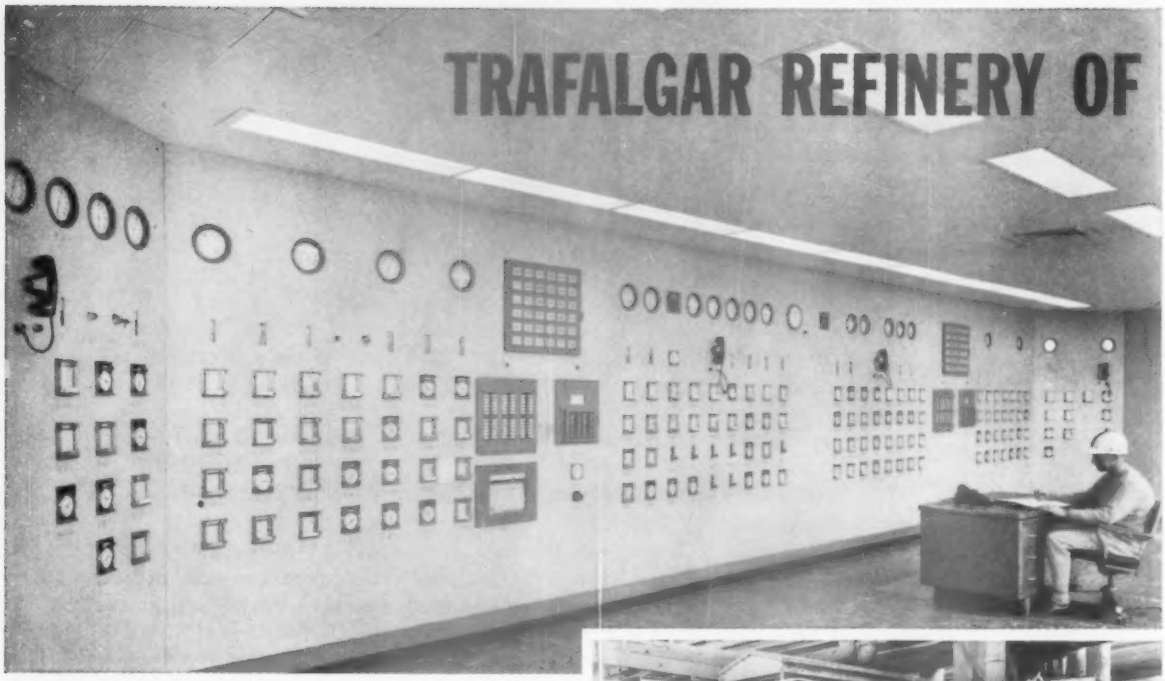
Accustomed to drifting on the tide of increasing demand, oil must now learn to swim upstream. It must look to progress and profits in increased efficiency, economy, and productivity rather than in mere expansion of volume.

This will require some drastic changes in oil's thought habits. Perhaps the present chaotic state of the oil market will provide the therapeutic "shock treatment" to jar it out of its mental fog and start it on a rational attack on its new problems.

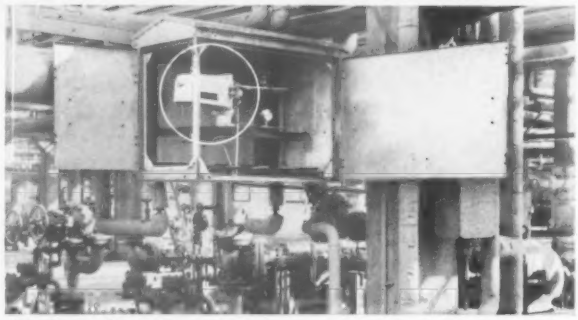
CREATIVE THINKING is needed on the supply side of the supply-demand equation. Efforts to expand demand certainly are needed and helpful, but there is little chance that they will sop up the whole surplus immediately. So strenuous efforts must be made to strike a balance by holding down supply.

This may seem elementary to people outside the industry. But it is a soul-shattering mental jar to oil men who are conditioned to devoting maximum efforts to increasing supply.

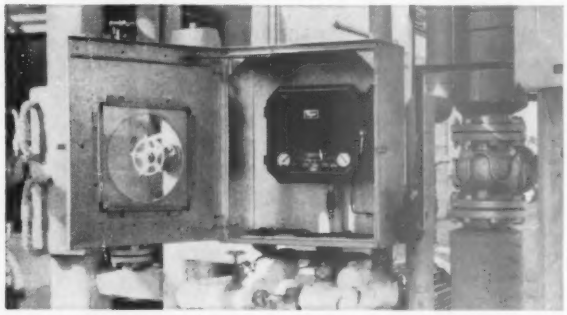
Other industries manage to fit supply to demand. There are many ways to prevent an oversupply of oil. But oil men can't apply them intelligently until they recover from the psychosis caused by the crumbling of their former environment and begin to think more rationally about today's conditions and how to cope with them.



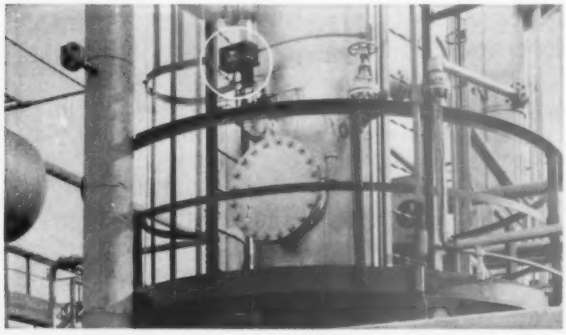
Centralized Taylor Control Panel for the four main process units at Trafalgar: (1) Crude Fractionation, (2) Catalytic Cracking, (3) Gas Plant, (4) Catalytic Reforming.



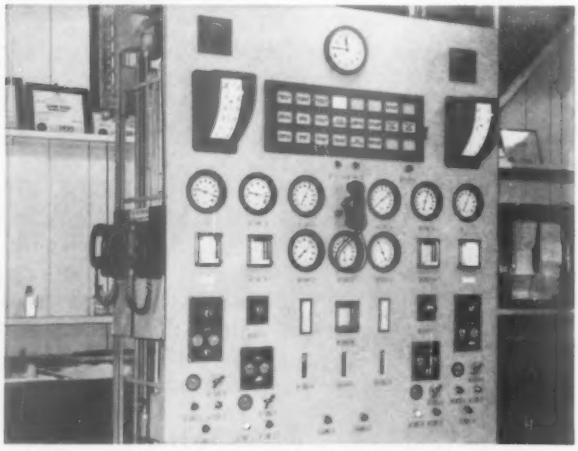
Taylor 333RD Differential Pressure Transmitters used on Catalytic Gasoline Splitter Feed.



Taylor Boiler Feed Water Pressure Transmitters — one of many applications.



TRANSAIRE Temperature Transmitter — installed on Catalytic Gasoline Splitter column bottoms.*



Utility control panel for power plant at the Trafalgar refinery.

*Reg. U.S. Pat. Off.

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Located at Bronte, Ontario, the 20,000 bpsd Trafalgar Refinery is one of Canada's newest and most practical. Designed and built by C F Braun & Co of Canada Ltd., it is a completely integrated refinery, processing a blended Canadian crude originating in Alberta, Saskatchewan and Manitoba. Refined products include several grades of motor gasoline, aviation gasoline, jet fuels, fuel oils and liquefied petroleum gases.

Transmitters, receivers, controllers and panel boards throughout this modern refinery were supplied by Taylor Instrument Companies of Canada, Ltd., working in close cooperation with Cities Service and Braun engineers. Such a highly integrated plant layout demands the utmost instrument dependability, and we are proud of the fact that Taylor's reputation merited this responsibility. Also that our Canadian subsidiary could supply the wide range of instruments needed to control all the variables involved in the diverse processing requirements of this complex refinery.

• • •

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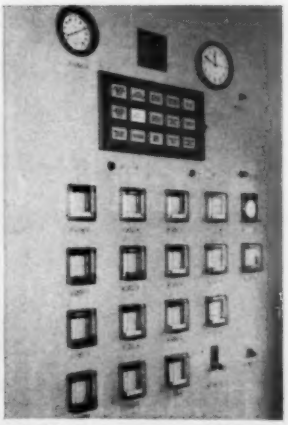
Lake Ontario fish thrive in Trafalgar Refinery's waste water.

This 6,000 gallon aquarium is supplied with effluent water actually more pure than originally drawn from the lake. The water treatment plant is reputed to be the most efficient ever installed in a refinery.



The Taylor control panel for the Trafalgar water treatment plant.

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While the Bank is prepared to provide all available information on the oil industry, it does not make recommendations regarding the purchase of individual oil stocks.

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RESOURCES EXCEED $3,000,000,000

U. S. Crude-Oil Reserves: Thousands of barrels

	Proved Reserves 1-1-59	Extensions and revisions	New discoveries*	Production in 1959	Proved reserves 1-1-60		Changes in 1959
Alabama	38,586	1,271		5,609	34,248	−	4,338
Arkansas	317,865	18,794	1,074	24,822	312,911	−	4,954
California†	3,866,430	195,155	8,080	307,158	3,762,507	−	103,923
Colorado	392,060	32,374	2,630	46,112	380,952	−	11,108
Illinois	607,589	60,856	2,539	76,577	594,407	−	13,182
Indiana	71,469	12,679	1,278	11,475	73,951	+	2,482
Kansas	922,434	96,918	17,089	118,938	917,503	−	4,931
Kentucky	126,357	30,965	7,252	28,250	136,324	+	9,967
Louisiana†	4,043,993	800,459	133,993	318,357	4,660,088	+	616,095
Michigan	44,968	16,689	4,213	10,535	55,335	+	10,367
Mississippi	378,688	43,644	14,336	47,331	389,337	+	10,649
Montana	337,799	− 1,464	3,300	30,367	309,268	−	28,531
Nebraska	69,242	28,326	5,700	22,710	80,558	+	11,316
New Mexico	894,121	222,100	11,909	102,341	1,025,789	+	131,668
New York	35,803	360		1,966	34,197	−	1,606
North Dakota	314,079	80,598	5,100	17,868	381,909	+	67,830
Ohio	70,809	9,320		5,992	74,137	+	3,328
Oklahoma	1,898,128	144,018	16,049	193,446	1,864,749	−	33,379
Pennsylvania	119,832	− 100		6,158	113,574	−	6,258
Texas†	14,322,216	1,346,675	129,784	939,001	14,859,674	+	537,458
Utah	198,639	35,655	207	39,962	194,539	−	4,100
West Virginia	52,104	1,320		2,165	51,259	−	845
Wyoming	1,408,717	114,865	4,679	125,323	1,402,938	−	5,779
Miscellaneous‡	3,989	5,906	150	852	9,193	+	5,204
Total United States	**30,535,917**	**3,297,383**	**369,362**	**2,483,315**	**31,719,347**		**+1,183,430**

*Only a limited area is assigned to each new discovery. †Includes offshore reserves. ‡Includes Alaska, Arizona, Florida, Missouri, Nevada, South Dakota, Tennessee, Virginia, and Washington.

Nation's Reserves Climb to New Highs

• Net gain in crude figures hit 1.18 billion barrels, and gas reserves climb a respectable 8.4 trillion cubic feet despite an all-time high rate of production. Revisions rather than discoveries account for most of gains.

OIL MEN made their best showing in 8 years by their activity last year in bringing the nation's supply of proved recoverable petroleum reserves to an all-time high.

The nation now holds peak reserves in crude oil, natural-gas liquids, and natural gas, according to the annual reports issued jointly by the American Petroleum Institute and the American Gas Association.

These records in reserves were achieved in the face of increased production of both the liquid hydrocarbons and natural gas. This is a sharp reversal from 1958 when production was down.

After this heavy 1959 use, reserves at the beginning of 1960 were:

... **Crude oil**—31,719,347,000 bbl., an increase of 1,183,430,000 over 1958.

... **Natural-gas liquids**—6,522,308,000 bbl., an increase of 318,290,000 over 1958.

These give a total liquid hydrocarbon reserve of 38,241,655,000 bbl., an increase of 1,501,720,000 over the year before.

... **Natural gas**—262.6 trillion cubic feet, an increase of 8.45 trillion cubic feet over 1958.

The committee making the annual study pointed out that proved reserves of oil and natural gas are those which experience indicates can be recovered by production methods now in operation. They do not include oil in unproved portions of partly developed fields or in strata favorable to the accumulation of oil but as yet untested.

A large percentage of the increase in total liquid hydrocarbon reserves came from extensions and revisions of previous estimates involving pools and fields discovered prior to 1959.

Reason for this is that no field of any consequence is ever fully developed during the year in which it is first discovered. For this reason, discoveries during a given year are often very small compared with reserves later developed in the same field through further drilling and increased knowledge of reservoir characteristics.

The size of the reserve increases is

U. S. Natural-Gas Reserves: Millions of cubic feet

	Proved reserves 1-1-59*	Extensions and revisions*	New discoveries	Change in underground storage†	Net production‡	Proved reserves 1-1-60	Changes in 1959
Arkansas	1,388,337	38,634	60,981	− 41	65,094	1,422,817	+ 34,480
California¶	8,966,522	39,321	56,230	−2,787	465,839	8,593,447	− 373,075
Colorado	2,349,240	236,396	26,266	164	115,907	2,496,159	+ 146,919
Illinois	170,528	11,655	279	11,112	18,464	175,110	+ 4,582
Indiana	30,569	4,682	186	3,444	3,793	35,088	+ 4,519
Kansas	20,233,847	279,359	97,365	9,895	639,063	19,981,403	− 252,444
Kentucky	1,215,329	− 4,467	12,810	3,709	68,000	1,159,381	− 55,948
Louisiana¶	55,111,862	6,100,270	1,509,830	0	2,868,042	59,853,920	+4,742,058
Michigan	498,113	17,877	5,400	13,442	19,429	515,403	+ 17,290
Mississippi	2,598,377	− 16,750	68,031	1,571	164,705	2,486,524	− 111,853
Montana	682,013	− 3,155	14,358	3,691	31,416	665,491	− 16,522
Nebraska	143,321	2,623	238	0	13,463	132,719	− 10,602
New Mexico	21,180,020	−2,758,846	196,341	−2,203	702,514	17,912,798	−3,267,222
New York	96,439	8,925	1,575	3,717	4,137	106,519	+ 10,080
North Dakota	1,124,470	97,481	0	0	15,409	1,206,542	+ 82,072
Ohio	818,052	− 60,859	11,170	16,714	36,311	748,766	− 69,286
Oklahoma	15,206,769	1,878,770	510,753	11,096	956,096	16,651,292	+1,444,523
Pennsylvania	870,014	217,298	35,180	48,342	118,862	1,051,972	+ 181,958
Texas¶	115,045,743	8,228,792	2,887,699	5,004	5,691,455	120,475,783	+5,430,040
Utah	1,058,051	176,088	74,371	0	44,261	1,264,250	+ 206,199
Virginia	38,421	2,125	375	0	2,289	38,632	+ 211
West Virginia	1,557,633	174,386	33,000	14,532	186,000	1,593,551	+ 35,918
Wyoming	3,649,818	254,558	145,434	− 102	202,644	3,847,064	+ 197,246
Miscellaneous§	108,549	7,946	52,876	20,026	7,435	181,962	+ 73,413
Total	**254,142,037**	**14,933,109**	**5,800,749**	**161,326**	**12,440,628**	**262,596,593**	**+8,454,556**

*Excludes gas loss due to natural-gas liquids recovery. †The net difference between gas stored in and gas withdrawn from underground storage, inclusive of adjustments and native gas transferred from other reserve categories. ‡Net production equals gross withdrawals less gas injected into producing reservoirs. Changes in underground storage and gas loss due to natural-gas liquids recovery are excluded. Fourth quarter production estimated in some instances. §Includes Alabama, Alaska, Arizona, Florida, Iowa, Maryland, and Missouri. ¶Includes offshore reserves.

appreciated more when these production figures are considered. Crude-oil production during 1959 was estimated at 2.48 billion barrels, a gain of 110 million barrels over 1958. Natural-gas liquids output was 385 million barrels, up 44 million; and the total of liquid hydrocarbons was 2.86 billion barrels, a gain of 154 million barrels. Natural-gas production rose 956 billion cubic feet to 12.4 trillion cubic feet.

Crude . . . Reserves of crude oil at the start of 1959 totaled 30,535,917,000, the record up to then.

The increase in reserves during the year was achieved by adding 3,297,383,000 through revisions of previous estimates and extensions of old pools. This is the greatest addition from these sources since 1951.

To these were added 369,362,000 bbl. of new reserves, discovered in new fields and new pools of old fields, making a grand total of nearly 3.7 billion barrels of proved reserves added. When production of 2.48 billion barrels is deducted, total proved reserves left are 31,719,347,000 bbl.

The 1959 increase in crude-oil reserves is a sharp gain over 1958 when only 235.5 million barrels of reserves were added. For several years prior to that, however, additions to reserves had been declining steadily.

Gas liquids . . . The industry's performance in adding reserves of gas liquids was not as outstanding as in the case of crude, but the addition still was substantial.

The industry started 1959 with 6.2 billion barrels of reserves. Revisions and extensions proved up 703.4 million barrels, a slight reduction from the year before. On top of this, production was a record 385 million barrels, allowing 318.2 million barrels to go into reserves. The addition to reserves also is a drop from the 1958 performance.

A fallacy . . . The API committee warned against trying to figure the life of domestic reserves by dividing the reserve estimates by the current rate of production.

The estimates on reserves cannot be used in measuring the rate at which the reserves can be produced with or without waste. Oil cannot be produced from the permeable rocks in which it occurs at any desired rate. The flow of oil through the pores of the oil-bearing rocks is definitely controlled by the physical factors of the reservoir.

The committee said today's known oil can be recovered only over a period of many years and at gradually declining annual rates. This has been widely demonstrated by past performances under all kinds of operating conditions.

Natural-gas . . . All-time high performances were staged by the natural-gas segment of the industry in several departments.

The new 262.6-trillion cubic feet total for reserves is a record. This was achieved in the face of an all-time record production of 12.4 trillion cubic feet, leaving a net gain to reserves of nearly 8.5 trillion cubic feet.

Gross additions to reserves in 1959 totaled nearly 20.9 trillion cubic feet, including newly discovered reserves of 5.8 trillion cubic feet and extensions and revisions of previous estimates amounting to more than 14.9 trillion cubic feet. The gross additions to reserves and new reserves discovered during the year were the third highest on record.

States showing the greatest increases for the year were Texas and Louisiana, which now account for more than two-thirds of the nation's proved recoverable natural-gas reserves. The two states had a year-end combined

U. S. Natural-Gas Liquid Reserves: Thousands of barrels

	Proved Reserves 1-1-59	Extensions and revisions	New discoveries*	Production in 1959	Proved reserves 1-1-60	Changes in 1959
Arkansas	34,150	148	302	2,583	32,017	− 2,133
California†	302,319	51,572	535	29,108	325,318	+ 22,999
Colorado	21,268	7,273	78	3,705	24,914	+ 3,646
Illinois	10,950	111	1,250	1,557	10,754	− 196
Indiana	119	23	1	19	124	+ 5
Kansas	199,552	3,210	623	6,473	196,912	− 2,640
Kentucky	37,472	13,612	1,492	3,286	49,290	+ 11,818
Louisiana†	1,195,955	203,094	32,201	73,452	1,357,798	+ 161,843
Michigan	1,502	189	27	156	1,562	+ 60
Mississippi	55,182	− 12,286	721	2,673	40,944	− 14,238
Montana	7,497	6,667	.....	653	13,511	+ 6,014
Nebraska	5,699	516	.....	783	5,432	− 267
New Mexico	417,238	16,004	8,886	19,088	423,040	+ 5,802
North Dakota	31,239	68,108	.....	1,419	97,928	+ 66,689
Ohio	1,618	− 314	.....	.....	1,304	− 314
Oklahoma	357,507	34,481	3,900	28,319	367,569	+ 10,062
Pennsylvania	3,685	40	20	68	3,677	− 8
Texas†	3,391,967	184,496	57,225	203,313	3,430,375	+ 38,408
Utah	14,899	17,948	.....	471	32,376	+ 17,477
West Virginia	63,286	− 28,185	2,171	3,106	34,166	− 29,120
Wyoming	50,876	27,215	107	4,919	73,279	+ 22,403
Miscellaneous‡	38	− 17	.....	3	18	− 20
Total United States	**6,204,018**	**593,905**	**109,539**	**385,154**	**6,522,308**	**+ 318,290**

*Only a limited area is assigned to each new discovery. †Includes offshore reserves. ‡Includes Alabama, Florida, and Missouri.

total of 180.4 trillion cubic feet of gas.

Texas reserves climbed in 1959 by more than 5.4 trillion cubic feet to a total 120.5 trillion. Louisiana's reserves advanced by 4.7 trillion cubic feet to a new total of 59.9 trillion.

Canada's gains . . . Estimated reserves of petroleum in Canada also stand at their highest in history.

The reserves committee of the Canadian Petroleum Association estimated the proved reserves of liquid hydrocarbons at 4 billion barrels, an increase during 1959 of 349 million barrels. Crude oil accounts for 3.5 billion barrels of the total.

Natural-gas reserves increased by 3.3 trillion cubic feet during the year, reaching the record of 26.6 trillion.

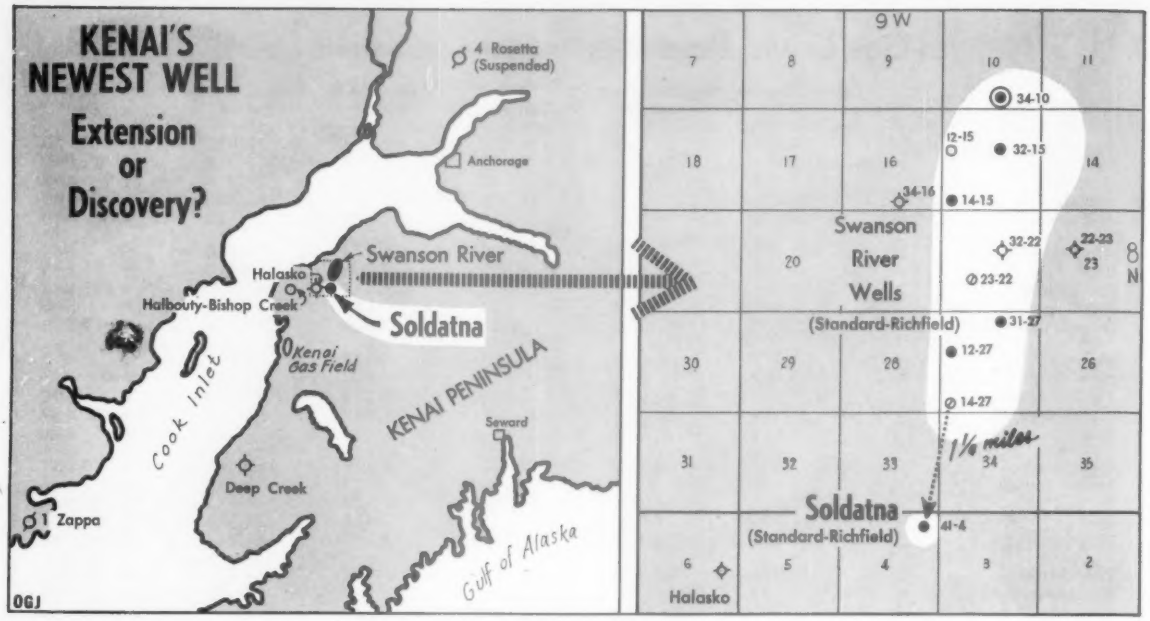
Canadian operators discovered 25 new oil fields and six new pools in old fields. Three of these fields each had an estimated proved reserve exceeding 5,000,000 bbl. Extensions and revisions of more than 5,000,000 bbl. were recorded at 15 of the older fields.

Thirty-eight new gas fields and six new pools in old fields were found during the year. Only one of these fields had an estimated proved reserve exceeding 100,000,000 M.c.f. Extensions and revisions of more than 100,000,00 M.c.f. were recorded at 11 of the older fields.

Canadian Reserves: Crude Oil, Natural-Gas Liquids, and Natural Gas

	Proved Reserves 1-1-59	Extensions and revisions	New discoveries*	Production in 1959	Proved reserves 1-1-60	Changes in 1959
CRUDE OIL (Thousands of barrels)						
Northwest Territories	52,409	.....	.....	439	51,970	− 439
British Columbia	8,958	10,574	687	818	19,401	+ 10,443
Alberta	2,572,610	365,594	89,917	111,010	2,917,111	+ 344,501
Saskatchewan	497,372	43,883	1,723	47,191	495,787	− 1,585
Manitoba	27,500	585	.....	5,031	23,054	− 4,446
Ontario	6,978	471	1,525	1,003	7,971	+ 993
New Brunswick	77	.....	.....	14,000	63,000	− 14
Total	**3,165,904**	**421,107**	**93,852**	**165,506**	**3,515,357**	**+ 349,453**
NATURAL-GAS LIQUIDS (Thousands of barrels)						
British Columbia	27,576	− 5,829	2,095	545	23,297	− 4,279
Saskatchewan	34,037	− 18,503	.....	609	14,925	− 19,112
Alberta	422,580	42,325	4,540	5,522	463,923	+ 41,343
Total	**484,193**	**17,993**	**6,635**	**6,676**	**502,145**	**+ 17,952**
Total liquid hydrocarbons	**3,650,097**	**439,100**	**100,487**	**172,182**	**4,017,502**	**+ 367,405**
NATURAL GAS (Millions cubic feet)						
Total in Canada	23,295,052	3,013,077	795,226†	498,019	26,605,336	+ 3,310,284

*Only a limited area is assigned to each new discovery. †Includes 4,566,000 M.c.f. added to underground storage.



New Strike Perks Up Oil Hopes in Alaska

- Standard of California-Richfield have another good Kenai well. It may be an extension of Swanson River.

ALASKA had its biggest oil well on the books last week.

Announcement by Standard Oil Co. of California and Richfield Oil Corp. confirmed the find. Soldatna Creek Unit well 41-4, only 1¼ miles south of the nearest drilling well in Swanson River field unit, was tested for 1,870 bbl. per day on ½-in. choke.

Production is from the Eocene-Hemlock sand, at 10,228-10,585 ft. This is the same sand that produces the Swanson River oil. Operators drilled the well to total depth of 11,315 ft. before testing. Location is in Section 4-7n-9w. Coastal Drilling Co. was the contractor.

Whether the strike means a new field for Alaska or a long southern extension of the elongate Swanson River structure is not known. The operating team of Standard of California and Richfield has finished five producers at Swanson River and has two more in final stages of drilling. All produce from the Hemlock at depths between 10,000 and 12,000 ft.

The new producer lies only a couple of miles east of a deep 1959 failure. Halbouty Alaska Oil Co. drilled the 1 Halasko-King dry hole to 12,037 ft. and abandoned it last May. The operation spotted in Section 6-7n-9w.

Standard of California and Richfield hold 92% of the 72,000-acre Soldatna Unit, which adjoins the Swanson River Unit on the south. Standard of California is operator in both the Soldatna Unit and at Swanson River. Sharing the 71,000-acre Swanson River Unit with Standard of California and Richfield are Union Oil Co. of California and Ohio Oil Co.

This is without a doubt the best oil well yet to appear on Alaskan scene. Of the five Swanson River producers, three were in the 300-450 bbl. class, one made only 50-100 bbl., and another (the 32-15) flowed as high as 1,000 to 1,300 bbl. daily. Besides the 1,870-bbl. flow at the SCU 41-4, a reported sand thickness of 230 ft. would place the new well in a class by itself. No other Alaskan well has reported such a pay as this.

H. G. Vesper, president of Western Operations, Inc., a Standard subsidiary in charge of the well, was treading lightly when he commented last week, "This new well confirms the commercial oil producing promise of Alaska."

Two-Year Dispute Settled at Baton Rouge

LABOR PEACE has returned at last to the nation's largest refinery at Baton Rouge.

Esso Standard Division of Humble Oil & Refining Co. came to terms with the Independent Industrial Workers Association after agreeing to kill its refinery mechanical classification.

Creation of the refinery mechanic had been a sore spot with union members because the classification cut across traditional craft lines.

The new agreement is the first for the refinery workers in nearly 2 years. During that time efforts to write a contract were thwarted by drives to elect a new bargaining agent and by charges of unfair labor practices.

The IIWA defeated the Oil, Chemical, and Atomic Workers Union and the Teamsters Union in elections late last year and won the right to bargain for some 4,000 production and maintenance workers. Laboratory workers also are covered by the new contract.

Although the union won its point in abolishing the refinery mechanic classification, the contract contains "work assignment provisions to give the necessary flexibility for performing mechanical work."

The contract grants no general salary increase but does provide for individual increases averaging 9.8 cents per hour for more than 1,800 employes. This is 46% of those covered by the agreement. Some of the increases are retroactive to last May.

Supervisors Cut Costs for California Co.

- It's their program, says Teasdel, and it's paying off in better work as well as in reduced operating expenses.

THE CALIFORNIA Co. has embarked on an intensive program to reduce operating costs.

It's a broad program, covering everything from improving casing design to pooling stenographic help.

It puts the responsibility on the line supervisor and, according to Calco President H. C. Teasdel, it has achieved "excellent results."

Teasdel reviewed his company's money-saving effort at the March meeting of the New Orleans chapter of the American Association of Oilwell Drilling Contractors.

Here are some of Calco's accomplishments:

. . . **Maintenance** requirements have been reduced to those essential for safe operation.

. . . **Drafting manpower** has been saved by eliminating "frills." Number of maps and charts has been reduced, color has been eliminated, and only freehand lettering is used.

. . . **Time has been saved** for key personnel by drastic cutting down on meetings, conferences, and convention attendance. Where committees are essential, membership has been cut.

. . . **Personnel needs** have been reduced some by pooling stenographic, filing, and drafting services. "We have but few private secretaries in The California Co."

. . . **Communication** costs have been cut by simplified telephone installations, restricting toll calls to the essential ones, and emphasizing use of teletype and longhand memo as cheaper ways of communicating.

. . . **Better drilling,** at lower cost, is being achieved by considering over-all efficiency rather than low bid in awarding contracts, better casing design, and better relations between engineers and contractors. The savings are being achieved, Teasdel said, without hurting the contractor.

Who's responsible . . . The line supervisor has the job of making Calco's cost-cutting operation work.

First, the company provides the supervisor with a cost sheet showing actual expenditures for each element of cost over a 1-year period.

"We then ask him to set performance objectives or targets for his segment of the organization each quarter," Teasdel explained. "Thus, the cost-control program becomes his program rather than the program of some swivel-chair official in one of the general administrative offices."

The targets of the supervisors are reviewed by higher management and sometimes scaled down if too great.

The accounting department tabulates actual expenditures quarterly for each supervisor, who can compare it with his target.

"This program has proved most successful in placing the initiative for a cost reduction program with the line supervisor, the man who can do most about it," Teasdel said. "I can tell you that the program has achieved excellent results."

Examples . . . Calco's biggest opportunities for cutting costs are in drilling, Teasdel said, since the company is principally involved in finding and producing oil.

One important aspect, he said, is in selection of equipment.

Teasdel said that on one 15,000-ft. well Calco used a 2,000-hp. rig rather than a 1,500-hp. rig offered by the low bidder. By taking the higher bid and the 2,000-hp. rig, the company saved $65,000 with a faster drilling rate.

"We are attempting to consider the over-all efficiency of the operation rather than being guided by only the low bid for the footage section of the hole," he said.

On casing, Teasdel said recent changes in design have cut costs on some wells as much as $13,000. On a number of offshore wells, Calco found it could eliminate the 16-in. conductor casing without affecting safety or operating requirements. This reduced costs by $113,000 on the first 11 wells.

Calco also is working to eliminate the peaks and valleys from its drilling program. A stabilized rate of drilling, Teasdel says, cuts costs for the company and the contractor as well.

It has found that greater use of diamond bits in deep wells is paying off. In one case alone, Teasdel said, the company saved $20,000.

The contractor . . . Teasdel had encouraging words for the drilling contractor.

He said operators should recognize that pressure on contractors to reduce drilling rates can force the contractor to cut his maintenance to the point where he takes too many chances with his equipment.

"Operators should make it their business to see that the rates they pay the driller are sufficient to enable him to keep his equipment in top shape and provide a satisfactory return on the heavy investment he has made."

The recent record federal lease sale for Gulf Coast offshore contracts should provide a "dynamic stimulus" to the drilling industry, he said.

Although annual rental is low on the 5-year federal leases, Teasdel said there is a "growing tendency in the industry to speed up the resolution of leases which have been acquired at heavy cost."

"Monies invested in such leases bring no return or provide no opportunity for tax write-off until exploratory tests are drilled and the potentiality of the tract determined."

Calco's Teasdel
. . . "we have few private secretaries."

Report on Refining

NEXT WEEK'S Journal will be the Annual Refining Issue, a long-standing feature covering the U. S. and Canadian refining industry. This year's report includes 57 pages of material telling where the industry is headed in refining.

The theme will be automation, higher gasoline yields, and more economical methods of refining.

And the issue will include the Journal's annual refining survey, which shows capacities, processes, and construction in every plant in the U. S. and Canada.

Watch for this important Journal report coming out March 28.

How 23 Companies See Desirable Stocks and

(Millions of barrels)

	Crude Oil U. S.		Crude Oil U. S. less West Coast		Crude Oil Texas Origin		Gasoline	
	April 1	Nov. 1	April 1	Nov. 1	April 1	Nov. 1	April 1	Nov. 1
Atlantic	250-260	255-265	207-215	212-218	110-115	110-115	200-205	165-170
Cities Service	250	250	210	210	110	110	200	160
Continental	247	247	213	213	91	91	195	160
Cosden	253	257	220	224	112	115	188	154
El Paso	250	260	220	230	110	114	180	150
Gulf	240	240	210	210	105	105	170	130
Phillips	245	245	215	215	110	110	180	150
Premier	250	250	220	220	90	90	165	135
Pure	252	255	224	227	108	109	195	158
Shamrock	250	250	220	220	110	110	190	150
Shell	250	255	220	225	110	112	190	155
Signal	240	240	219	219	105	105	180	140
Sinclair	240	250	205	215	112.5	115	194-198	160-164
Socony Mobil	251	256	218	223	108-116	110-118	198	166
Southern Minerals	245	255	215	225	110	115	195	165
Standard (Calif.)	255	260	220	225	105	110	200	163
Standard (Ind.)	250	250	220	220	105	105	200	165
Standard (N. J.)	255	255	225	225	112	112	210	175
Standard (Ohio)	255	260	220	225	110	110	185	155
Sun	250	255	220	225	115	118	185	155
Sunray	250	250	217	217	107	107	190	160
Texaco	255	255	225	225	115	115	195	160
Tidewater	250	255	220	225	110	115	185	150
Composite	**249.7**	**252.9**	**217.4**	**220.5**	**108.5**	**109.8**	**190.9**	**156.6**

No Company's Stocks Are Too High; It's

THE TEXAS Railroad Commission again probed the riddle of excess oil stocks last week, but it failed again to find the key to the mystery of whose stocks are excessive.

A score of large and small integrated refining companies, in sworn testimony at a public hearing, disclosed their individual inventories of crude and principal products. The consensus was that, by and large, these companies' stocks are not greatly above the levels they consider desirable for them to hold at the end of the winter season.

In a quick calculation, Commissioner William J. Murray, Jr., said that the gasoline stocks of the companies testifying totaled about 1½ million barrels above what they consider desirable, whereas national stocks of gasoline are some 36½ million barrels above what the industry estimates to be desirable. He asked:

"Where are the other 35 million barrels? Are stocks 'excessive' only if someone else holds them?"

He got no answer.

The general picture was that crude-oil stocks are not particularly excessive. Some individual companies are a bit long, some a bit short.

Virtually all of them reported that their stocks of distillate have been high all winter. But most of them anticipated that the substantial reduction in refinery runs in recent weeks, plus the unusually cold weather in March, would work these down so that the heating season would end with distillate stocks about in line with desirable levels—at least as far as these individual companies are concerned.

Top-management attention is being given to inventory control, the officials of several major companies testified.

Such statements were more or less in answer to opening comments by Chairman Ernest O. Thompson, who declared that the Railroad Commission has done its part by holding allowables down so that crude stocks are not in surplus. The excess of products stocks which has prevailed for so many months is due to actions of the industry, he said, and he asked who it is that runs the refineries.

Thompson compared national stock levels as of March 4 with the estimates of desirable levels given the Railroad Commission by the industry a year ago. This showed crude stocks 1.7 million barrels low, but gasoline stocks 36.2 million high, kerosine 0.2 million high, distillate 19.7 million high, and residual 4.7 million high.

This year's composite estimate of desirable spring and fall stock levels (table above) does not differ greatly from estimates given the commission a year ago (OGJ, March 30, 1959, p. 94). The estimates for crude are down some 5 or 6 million barrels. The desirable level for gasoline works out a little higher, and for other stocks slightly lower.

In addition to general comments that it is now company policy to work with lower inventories than formerly, Continental Oil Co. offered these observations:

. . . **Changed conditions** in the in-

Forecast Demand Increase

Kerosine		Distillate		Residual		Demand increase 1960 over 1959, %
April 1	Nov. 1	April 1	Nov. 1	April 1	Nov. 1	
18	30	65	165	34	47	3.7
18	35	70	160	38	49	3.5
16	30	65	160	35	50	3.0
17	34	65	156	37	48	1.0
16	32	65	160	32	50	4.0
18	35	45	145	35	45	3.5-4.5
16	35	65	155	36	45	3.5
12	30	40	130	25	40	0
17	34	68	159	39	50	4
16	30	60	160	25	45	4
18	38	67	162	38	48	3.2
15	25	60	125	40	50	1.5-2
18	38	70-72	160-162	38-40	50-52	3.0
18	37	66	174	38	49	3.2
17	32	75	165	45	55	3.0
20	40	70	161	40	42	4.5
15	30	65	160	40	50	3-4
17	34	71	170	42	54	3-4
18	35	65	160	37	50	3.5
17	32	65	150	40	50	3.5
18	30	70	160	40	50	3.5
19	37	69	163	45	57	4.0
16	32	65	160	35	45	3.5-4
16.2	33.3	64.9	157.6	37.3	48.8	3.25

Just the Total That's Off

dustry make it unnecessary to carry such large inventories as in prior years.

... **There is excess** producing capacity and excess refining capacity, therefore no need to maintain inventories to meet an unexpected surge in demand.

... **Technological** advances such as automation at leases, pipelines, and refineries permit faster delivery and greater flexibility.

... **Something** like two-thirds of reported inventories are unavailable, consisting of pipeline fill, tank bottoms, in-transit stocks, and minimum working inventory. As of the present, approximately 179 million barrels of crude stocks can be considered unavailable, 78 million of gasoline, 35 million of kerosine and distillate, and 15 million of resid.

The companies appearing at the hearing had not been asked to give figures on refinery runs, but some of them volunteered this information. Samples:

Atlantic: Runs have been cut 15%.

Cities Service: Runs this year have averaged 10% below a year ago.

Cosden: Running refinery at 17% below capacity.

Gulf: Runs reduced 24,000 bbl. per day below 1959; now operating refineries at 81% of capacity versus 88% a year ago.

Humble (the new Humble covering all U. S.): February runs were 795,000 bbl. per day versus 876,000 in February 1959, a cut of 81,000; cutting another 10,000 in March.

Phillips: Refining at 82% of capacity.

Shell: Cut runs, resulting in building up crude stocks 900,000 bbl. in March; now has 750,000 bbl. surplus crude in storage.

Sinclair: Accident in Chicago refinery causing crude stocks to accumulate 34,000 bbl. per day.

Sun: Has crude to sell and building crude inventories 15,000 bbl. per day.

Suntide: Cut runs to 40,000 bbl. in January, or 7,000 below December; operating at 62% of capacity.

Lower Flow in Texas

. . . for April, but cut is not as deep as most ask.

THE TEXAS Railroad Commission cut back crude-oil output in Texas for April, but not as much as most interested parties advised.

It put prorated wells on a 9-day producing schedule for the 30-day month of April, compared with 10 days in 31-day March.

This makes the April allowables average 2,814,252 bbl. per calendar day, a reduction of 123,029 bbl. from the March figure.

Purchasers nominated to buy only 2,530,112 bbl. per day, a reduction of 141,252 from their March nominations. The U. S. Bureau of Mines estimated the demand for Texas crude at 2,350,000 bbl. per day, a reduction of 200,000 from its March estimate.

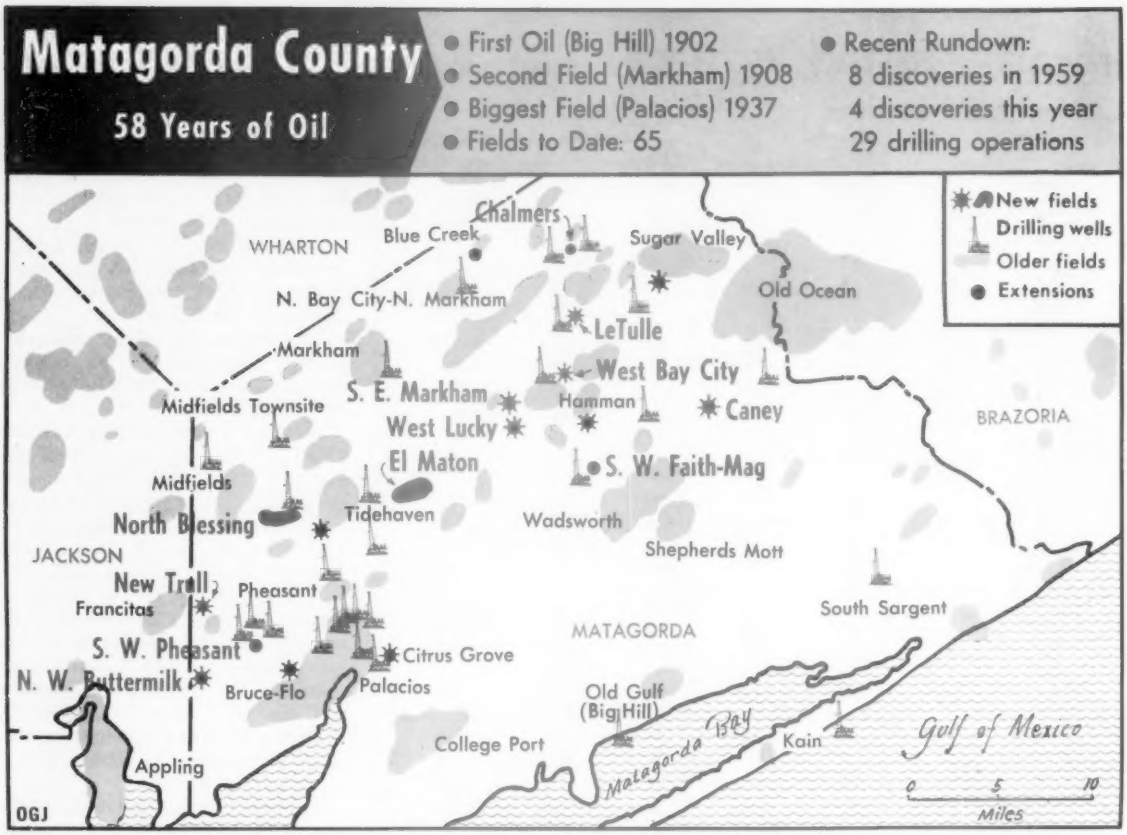
A big majority of the purchasers requested 8 producing days, and this was endorsed by spokesmen for several groups of producers. Two buyers asked for 10 days, five for 9 days, and one for 7 days in April. The latter was Indiana Oil Purchasing Co., which is prorating its buying to 80% of January purchases.

This purchaser proration by Indiana was the basis of producer requests for an 8-day allowable. They cited inequities among producers as a result, and asked that the state's output be cut back enough to eliminate the purchaser proration. The commission attempted in vain to get Indiana officials to promise that it would lift its proration in Texas if allowables were cut to 8 days.

Observers speculated that failure to get such assurance from Indiana Purchasing was one reason why the commission set allowables at 9 days.

ALLOWABLES BY DISTRICTS

District—	April	Change from Mar. 5
1. Southwest	51,378	— 581
2. Gulf Coast	114,088	— 6,145
3. Gulf Coast	356,358	— 12,730
4. Southwest	187,972	— 8,049
5. East Central	30,632	— 1,218
6. Outside East Texas Field	119,252	— 4,751
6. East Texas Field	134,059	— 6,981
7-B. N. Central	167,502	— 4,972
7-C. W. Central	137,729	— 5,530
8. West Texas	1,110,492	— 55,992
9. North Texas	258,087	— 2,707
10. Panhandle	146,703	— 995
TOTAL	2,814,252	— 110,651



Old South Texas County in New Play

• Drilling is at a rapid clip again in Matagorda County, which has had oil since the turn of the century. Discoveries and field extensions dot the area as a result of the latest wave of exploration.

THE INTENSIVE wildcat drilling play that has been sweeping across Matagorda County in the deep middle of Texas' old coastal salt dome region shows no sign of letting up.

Instead, an increasing amount of new drilling has been started or planned. Both wildcatting and extension and deeper exploratory drilling in and around existing fields are spreading to other parts of the county. Some long-inactive areas and prospects are being reactivated.

There are now 29 active drilling operations. These include only those on which rigs are actually working or those in the process of testing and completion. Ten are far enough from known fields to be classed as wildcats. Most of the remaining 19 so-called field wells are extensions or exploratory tests in new areas.

Currently represented are nearly 30 separate or combinations of operating companies or independents. Additional companies—large and small—are joining the play.

New work is making Matagorda County the busiest spot in South Texas. In number of active drilling operations, it now passes former front-running sister coastal counties, Galveston and Jefferson, and busy Duval County in the far south.

Scene of some of the earliest known oil and gas production in South Texas and already widely drilled in successive waves of exploration that have swept the coastal region over the intervening years, Matagorda County continues a prime hunting ground for additional fields and new production.

Current activity . . . The current play is directed primarily at the prolific deeper Frio sands along a northeasterly-southwesterly trend through the north half of the county. It is spurred by a continuation in the steady succession of oil and gas discoveries that marked last year's exploration.

Despite the long list of fields previously proved, 12 additional productive areas have been found within the past year. Four of the discoveries were chalked up this year, and eight were opened during 1959. This was twice the number of discoveries credited to any previous year. At least several of them already have shown promise by additional development of becoming sizable and important producing areas.

Greatest concentration of field activity now is in the Palacios area, where seven rigs still are running in developing the relatively new north extension part of the field, still undefined.

Palacios field, discovered in 1937,

has proved the county's largest producing area, now stretching nearly 8 miles from south to north, and 4 to 5 miles from east to west.

Development following the Palacios discovery was slow and really did not begin to become active until late in 1957 and 1958. Since then, the productive area has spread rapidly, engulfing a succession of separate nearby fields, including North Collegeport, Harrison, and Bruce-Flo.

Palacios is moving nearer to newer fields, such as Pheasant, Southwest Pheasant, and New Citrus Grove. Although it has oil reservoirs, its chief development has been in gas and condensate. It claims some of the biggest and richest gas-condensate wells on the coast.

School Tax Killed

. . . as Sinclair's attack on Wyoming levy is upheld.

SINCLAIR OIL & Gas Co. has won a major court victory over Wyoming state law providing for a special tax assessment in school districts which have no high schools.

District Judge Glen Stanton ruled in Green River that the tax levy is unconstitutional. Sinclair had argued in this first court test of the special tax levy that the law requires the 5-mill levy regardless of its need, and that therefore it was illegal.

Stanton previously had issued a temporary restraining order against collection of the tax.

Purpose of the tax, supported by the Wyoming Education Association and the Wyoming School Trustees Association, was to create a special fund to pay transportation and other expenses of students who reside in school districts which have no high schools.

Wyoming has 90 such districts in which students travel to the nearest high school in another district (OGJ, Dec. 28, p. 73).

Sinclair's suit to test the law was filed against a $66,878 levy in School District 25 at Bairoil in Sweetwater County. The oil company contended that, since there are only 13 high-school students in the district, payment would be $59,272 over what it would cost to send them to the nearest school, in Rawlins.

Sinclair said the levy was in excess because it created a fund over the amount needed to send the students to high school. This excess, under the tax, would be divided among the county's other four high schools.

The 5-mill levy was in addition to a 6-mill levy limit for state school funds and a 5-mill levy for county schools.

watching WASHINGTON

Clyde La Motte

• Don't expect major changes in import plan . . .

MARCH 11 passed quietly, with no candle-lit cake or other observance of the fact that the mandatory oil import control program was a year old on that date.

It is immediately clear to any observer that the control program has been no cure-all for the industry's ailments. On the other hand, it shows no indication at this point of growing into a giant octupus with its tentacles wrapped around every phase of the industry—as some had feared would happen once the control program was launched.

It should be equally clear that we are going to have the program with us for the foreseeable future. And few, if any, major changes are likely. True, some complaints continue. Some producers feel the controls need to be tightened to be really effective. Some majors are still chafing, especially over the granting of import quotas to inland refiners.

For the most part, however, these complaints apparently are being made mostly for the record, because those who make them realize there is little chance of getting any basic changes made in the control plan.

• Weighing results after a year of trial . . .

JUST WHAT has the control program accomplished in its first year of existence?

That birthday question was put to Matthew V. Carson, the administrator of the program. As Carson sees it, it has done these things:

It arrested the upswing in imports. Those who had feared that a rising tide of foreign oil would engulf the domestic industry now have the protection of the dyke the control program provides.

It may have encouraged more domestic drilling. Statistics show there was a modest upswing in drilling in 1959. And certainly no one could argue that import restrictions have discouraged domestic drilling.

There may have been some side benefits, too. For instance, Carson feels that the controls program has helped give the industry a little more stability. When imports were uncontrolled, a big unknown factor affecting any forward planning was how much oil would be imported.

With the control program, one knows in advance the approximate level of imports and is able to plan accordingly.

• Canadians are urged to 'take it easy' . . .

LOOKING to the future, one can see some clouds on the horizon, but they have not reached storm proportions.

One of the potential danger zones is the unrestricted flow of Canadian crude by overland routes into the U. S. There has been some increase in the use of Canadian crude in the upper Midwest. And there is continuing talk of a crude line to Chicago to move upwards of 200,000 bbl. daily.

Taking recognition of this, Carson issued a mild warning to the Canadians at a recent speech in Toronto. He told them frankly that a big upsurge in Canadian crude to the U. S. would cause considerable concern. He advised them to take it easy on such projects, bearing in mind that if Canadian crude begins to have a substantial impact, the U. S. would have to take another look at the problem.

There was no indication that the Canadians resented this warning. Most of them apparently realize that the solution to their crude surplus problem lies in Canada, and can not be dependent to any large extent on U. S. markets.

All in all, Carson is not unhappy about the progress of the control program. He readily concedes that the domestic industry still has its problems, but he points out that he has said all along that imports constituted only a part of the industry's difficulties.

Import Exchanges Since First of Year

Here are the deals made so far this year

(Crude and unfinished oil exchanges for January 1-June 30 period)

DISTRICTS 1-4

Refiner, importing company	Barrels daily	Origin of foreign crude
Ashland Oil & Refining		
Advance Refining	321	S. Arabia and Ven.
Elk Refining	52	S. Arabia and Ven.
Illinois Farm Supply	595	S. Arabia and Ven.
Indiana Farm Bureau Coop.	1,565	S. Arabia and Ven.
Pennsylvania Refining	152	S. Arabia and Ven.
Quaker State	355	S. Arabia and Ven.
R. J. Oil & Refining	429	S. Arabia and Ven.
South Penn	325	S. Arabia and Ven.
TOTAL	3,794	
Atlantic Refining		
Bell Oil & Gas	2,174	Venezuela
Clark Oil & Refining	3,649	Venezuela
Crown Central	2,013	Venezuela
Danaho Refining	380	Venezuela
Delhi-Taylor	3,616	Venezuela
Delhi-Taylor (Mayfair Minerals)	1,070	Venezuela
Great Western	227	Venezuela
Howell Refining	507	Venezuela
Naph-Sol Refining	777	Venezuela
Northwestern Refining	8,710	Venezuela
Ohio Oil Co.	6,729	Venezuela
Oriental Refining	469	Venezuela
Shell Oil Co.	8,593	Venezuela
Southland Co.	2,270	Venezuela
TOTAL	41,184	
Gulf Oil Corp.		
Cities Service	18,000	Kuwait and Iran
Continental	3,324	Kuwait
Ohio Oil Co.	3,500	Kuwait
Plymouth Oil	3,915	Kuwait
Seminole Asphalt	225	Kuwait
Union of California	426	Kuwait
United Refining	2,270	Kuwait
Vulcan Asphalt	210	Kuwait
Warrior Asphalt	138	Kuwait
TOTAL	32,008	
Monsanto Chemical Co.		
Cross (Henry H.)	403	Venezuela
TOTAL	403	
Phillips Petroleum		
Allby Asphalt	292	Venezuela
Allied Materials	301	Venezuela
Cosden Petroleum	2,000	Venezuela
Ingram Oil & Refining	1,925	Venezuela
Kerr-McGee	4,413	Venezuela
Petroleum Refining	234	Venezuela
TOTAL	9,165	
Sinclair Oil Corp.		
Anchor Gasoline	131	Kuwait
Bayou State Oil	93	Kuwait
Big West Oil	290	Kuwait
Century Refining	316	Kuwait
Champlin	1,189	Kuwait
Cracker Asphalt	141	Kuwait
Elk Refining	500	Kuwait
Empire Petroleum	590	Kuwait
Frontier Refining	2,455	Kuwait
Ida Gasoline	26	Kuwait
Jet Fuel Refinery	58	Kuwait
Mid-America Refining	291	Kuwait
Murphy Corp.	3,260	Venezuela
South Penn	175	Kuwait
Standard of Ohio	6,000	Kuwait
Texstar Corp.	216	Kuwait
Waskom Natural Gas	122	Kuwait
Wickett Refining	328	Kuwait
Wyandotte Chemicals	308	Kuwait
TOTAL	16,489	
Standard of California		
Ashland Oil & Refining	7,475	S. Arabia and Ven.
Standard of Ohio	2,608	Venezuela
Sunray Mid-Continent	2,000	Venezuela
Sunray Mid-Continent	1,000	Saudi Arabia
Western States	187	Saudi Arabia
Western States	93	Saudi Arabia
Western States	93	Saudi Arabia
TOTAL	13,456	
Socony Mobil Oil Co.		
Berry Refining	735	Venezuela
Calumet Refining	233	Venezuela
Colorado Oil & Gas	2,094	Venezuela
Continental	6,056	Venezuela
Continental	6,056	Venezuela
Cosden Petroleum	2,530	Venezuela
Dow Chemical	2,040	Venezuela
Empire State	409	Venezuela
Husky Oil	778	Venezuela
Kendall Refining	540	Venezuela
Quaker State	755	Venezuela
Rado Refining	46	Venezuela
Rock Island Refining	1,748	Venezuela

REFINERS have been swapping on an average basis of 1.06 bbl. of high-priced domestic crude for each barrel of cheaper foreign crude available under an import quota.

These swaps involve almost a third of the total crude import allowable, according to a report issued last week by the Oil Import Administration.

The OIA reported that 301,041 bbl. daily of imported crude is being exchanged for domestic crude during the current January-July allocation period. Total import allocations for Districts 1-4 and District 5 are 938,313 bbl. daily.

The swap agreements vary, depending on the specific type of foreign and domestic oils exchanged.

Also there are other factors, including changes in posted prices and arrangements concerning who will pay transportation and other costs. As a result the OIA did not say how much domestic crude was swapped for foreign crude. It will be after the exchanges actually have taken place before exact figures can be available.

A tabulation by The Oil and Gas Journal, however, shows that 319,725 bbl. daily of domestic crude is involved in the exchanges for 301,041 bbl. daily of foreign crude.

In Districts 1-4, 16 oil companies are exchanging about 275,725 bbl. of domestic crude to 102 companies for their import quotas of 262,225 bbl. daily of foreign crude. In District 5, six companies are getting 38,816 bbl.

Are Following No Set Pattern

Socony Mobil con't		
Signal Oil & Gas	3,000	Venezuela
Sonneborn Sons	154	Venezuela
South Penn	200	Venezuela
Sunray Mid-Continent	1,065	Venezuela
Sunray Mid-Continent	397	Venezuela
Texas Gas Corp.	806	Venezuela
Three Rivers Refinery	125	Venezuela
Westland Oil Co.	215	Venezuela
Wolf's Head	247	Venezuela
TOTAL	30,229	
Standard of Indiana		
Berry Asphalt	358	Venezuela
Hunt Oil Co.	262	Venezuela
Monsanto Chemical	3,200	Venezuela
Shell Oil	3,297	Venezuela
Standard of Ohio	1,099	Venezuela
Vickers Petroleum	1,716	Venezuela
TOTAL	9,932	
Standard of New Jersey		
Ashland Oil & Refining	5,000	Venezuela
Ashland Oil & Refining	800	Venezuela
Eddy Refining	264	Venezuela
El Paso Natural	2,157	Venezuela
Phillips Petroleum	18,682	Venezuela
Pure Oil Co.	14,762	Venezuela
Tennessee Gas	3,932	Venezuela
TOTAL	45,597	
Standard of Ohio		
Leonard Refineries	3,058	Venezuela
TOTAL	3,058	
Sun Oil Co.		
American Petrofina	4,497	Venezuela
Champlin	2,000	Venezuela
Crown Central	2,013	Venezuela
Hunt Oil Co.	500	Venezuela
Laketon Asphalt	339	Venezuela
Standard of Ohio	3,000	Venezuela
TOTAL	14,244	
Sunray Mid-Continent		
Kerr-McGee	381	Venezuela
Midland Cooperatives	1,598	Venezuela
TOTAL	1,979	
Texaco Inc.		
Anderson-Prichard	3,502	Colombia
Cooperative Refinery	4,109	S. Arabia; Colombia
National Cooperative	3,266	Colombia
Petroleum Specialties	926	S. Arabia; Colombia
Shamrock Oil & Gas	2,590	Colombia
Uinta Oil Refining	156	Saudi Arabia
TOTAL	14,549	

Tidewater Oil Co.		
Bryson Pipeline	80	Neutral Zone
Evangeline Refining	175	S. Arabia and N. Zone
Famariss Oil & Refining	184	Neutral Zone
Farmers Union	2,229	Neutral Zone
Gladieux Oil Sales	74	Neutral Zone
Jarvis, S. D.	173	Neutral Zone
Shell Oil	9,000	Venezuela
Sioux Oil Co.	576	Neutral Zone
Skelly Oil	5,380	Neutral Zone
South Penn	547	Neutral Zone
Texas City Refining	3,642	Venezuela
Texas Eastern	1,975	S. Arabia and Kuwait
TOTAL	25,550	
Western Natural Gas Co.		
Cactus Petroleum	309	S. Arabia and Kuwait
Monarch Refining Co.	279	Neutral Zone
TOTAL	588	
DISTRICT 5		
Douglas Oil Co.		
Envoy Petroleum Co.	906	Venezuela
TOTAL	906	
Richfield Oil Corp.		
Douglas Oil Co.	1,400	Venezuela
Douglas Oil Co.	1,694	Venezuela
Edgington Oil Refineries	2,604	Kuwait, Iran, Japan
Macmillan Petroleum	1,940	Kuwait, Iran, Japan
Mohawk Petroleum	1,532	Kuwait, Iran, Ven.
TOTAL	9,170	
Socony Mobil Oil Co.		
Mohawk Petroleum Corp.	1,532	Qatar
TOTAL	1,532	
Standard of California		
Douglas Oil Co.	2,500	Sumatra
Fletcher Oil Co.	3,926	Sumatra
Richfield Oil Corp.	5,742	Saudi Arabia
TOTAL	12,168	
Texaco Inc.		
Caminol Co.	2,114	Saudi Arabia
Socony Mobil	10,000	S. Arabia; Sumatra
TOTAL	12,114	
Wilshire Oil Co.		
Palomar Oil & Refining	378	Iran and Kuwait
Standard of California	730	Iran
Standard of California	81	Kuwait (unfinished)
Sunland Refining	1,737	Iran, Kuwait
TOTAL	2,926	

daily of foreign crude from 12 domestic companies in exchange for about 44,000 bbl. daily of domestic crude.

The terms . . . An examination of the individual exchange agreements filed with the OIA shows there is a fairly wide range of terms. This stems not only from types of crudes involved but on the bargaining position of the parties involved, location of refineries, and other factors.

For example, Atlantic Refining Co. is "paying" only about 37,700 bbl. daily of domestic crude for 41,184 bbl. daily of Venezuelan crude. Gulf Oil Corp., on the other hand, is having to swap about 34,400 bbl. daily of domestic crude to obtain 32,008 bbl. daily of crude from Kuwait and Iran.

And Socony Mobil Oil Co. is swapping about 45,500 bbl. daily of domestic crude for 30,229 bbl. daily of foreign crude.

Standard Oil Co. (N.J.) affiliates are exchanging about 41,600 bbl. daily of domestic crude for 45,597 bbl. daily of Venezuelan crude. In Tidewater Oil Co.'s agreements with 13 firms, Tidewater is averaging an almost even barrel-for-barrel swap, getting 25,550 bbl. of foreign crude in exchange for about 25,575 bbl. of domestic crude.

On the West Coast, Standard of California is swapping 14,200 bbl. of domestic crude for 12,168 bbl.

New Texas Gas Line Will Serve Power Plants

• Deliveries to Fort Worth-Graham areas on Old Ocean's new $21 million system scheduled to start in December.

OLD OCEAN Fuel Co., Fort Worth, has let contract for construction of its $25,000,000 gas line from Old Ocean field on the Texas Gulf Coast to Fort Worth and Graham, Tex.

Actual construction of the 370-mile system will be kicked off early in May and completed in mid-December this year.

The contract for the 24, 20, and 16-in. system was let to H. B. Zachary Co., San Antonio, and O. R. Burden Construction Corp., Tulsa, as joint venturers. The Zachary-Burden bid was lowest of five received on the project.

Old Ocean Fuel Co. is a subsidiary of Texas Electric Service Co., Fort Worth, and will supply gas as boiler fuel for the latter's electric-generating plants in the Fort Worth and Graham areas.

Texas Electric last year signed 20-year contracts with Old Ocean field producers to buy up to 250,000,000 cu. ft. of gas a day. Pan American Petroleum Corp. is the unit operator and biggest gas producer in the Old Ocean area of Matagorda and Brazoria counties.

Purchase price for this gas has never been disclosed by Texas Electric. But informed sources have pegged the initial price at 21.5 cents an M.c.f., escalating 2 cents every 4 years to a top of 29.5 cents. A Texas Electric official admitted to the Journal last year that "this price is in the ball park." The price, since this is an intrastate sale, is not subject to adjustment by the Federal Power Commission (OGJ, June 15, 1959, p. 67).

December changeover . . . Old Ocean Fuel will start delivery of gas to Texas Electric's Fort Worth and Graham generating plants on December 25 this year. This is the date on which an existing contract with United Gas Pipeline Co. expires.

The new line's main trunk will consist of 24 and 22-in. pipe between Old Ocean and Fort Worth. The extension from Fort Worth on to Graham will be 16 in.

Each of four larger boilers at Texas Electric's Fort Worth plants burns more than 1,000,000 cu. ft. of gas per hour under full load. The huge boiler at the company's new Graham station will consume more than 2,000,000 cu ft. per hour at capacity.

The company's four other generating plants will continue to run on gas supplied by Lone Star Gas Co. and Warren Petroleum Corp. under contracts extending from 4 to 10 years.

Third Movie Lot Well Dry

CONTINENTAL Oil Co. has drilled its second dry hole after making a good discovery on its lease located on studio property of Metro-Goldwyn-Mayer in Culver City, Calif.

The company did not release details of the dry hole except to say that it has been "temporarily abandoned." The first dry hole has been plugged and abandoned.

The first well came in last November as a producer at 8,807 ft. It tested at 720 bbl. daily. Later indications are the well did not live up to expectations.

All three wells have been drilled from the same soundproofed platform. Continental has 850 acres leased in the area. The company now is deciding whether to try another directional well, move to another location, or possibly make a deal with another operator.

PROCESSING BRIEFS . . .

Independent Petroleum Workers won the runoff election at Esso's Bayway refinery last Wednesday, defeating OCAW by a vote of 699 to 647. OCAW had been favored as a result of topping the field in the initial election February 25 with 597 votes to the Independents 533. The Bayway loss on top of the defeat at Baton Rouge leaves the OCAW with only one of Jersey Standard's three big refineries. That's the big Humble plant at Baytown, Tex.

Sohio is starting up a new $300,000 plant to produce asphalt products at its Lima refinery. The new facility will take certain grades of asphalt from other Sohio refineries and produce other asphalt products. It has a capacity of between 5 and 10 million gallons a year.

Chemical production and research facilities costing $3.002 billion will be built in the U. S. during the 3-year period of 1959 through 1961, according to Manufacturing Chemists Association estimates. Petrochemical construction is expected to account for more than $454 million of the total.

Columbia-Southern Chemical Corp. is building a $1-million ethylene-dichloride plant adjoining their caustic-chlorine facilities at Lake Charles, La. The new plant is expected to go on stream in September. Ethylene feed stock will be obtained from Petroleum Chemicals, Inc.

Sinclair-Koppers Chemical Co. will build a petrochemical plant at Houston to produce styrene monomer, synthetic rubber, latex, and other products. It is expected to be completed and in operation by mid-1961.

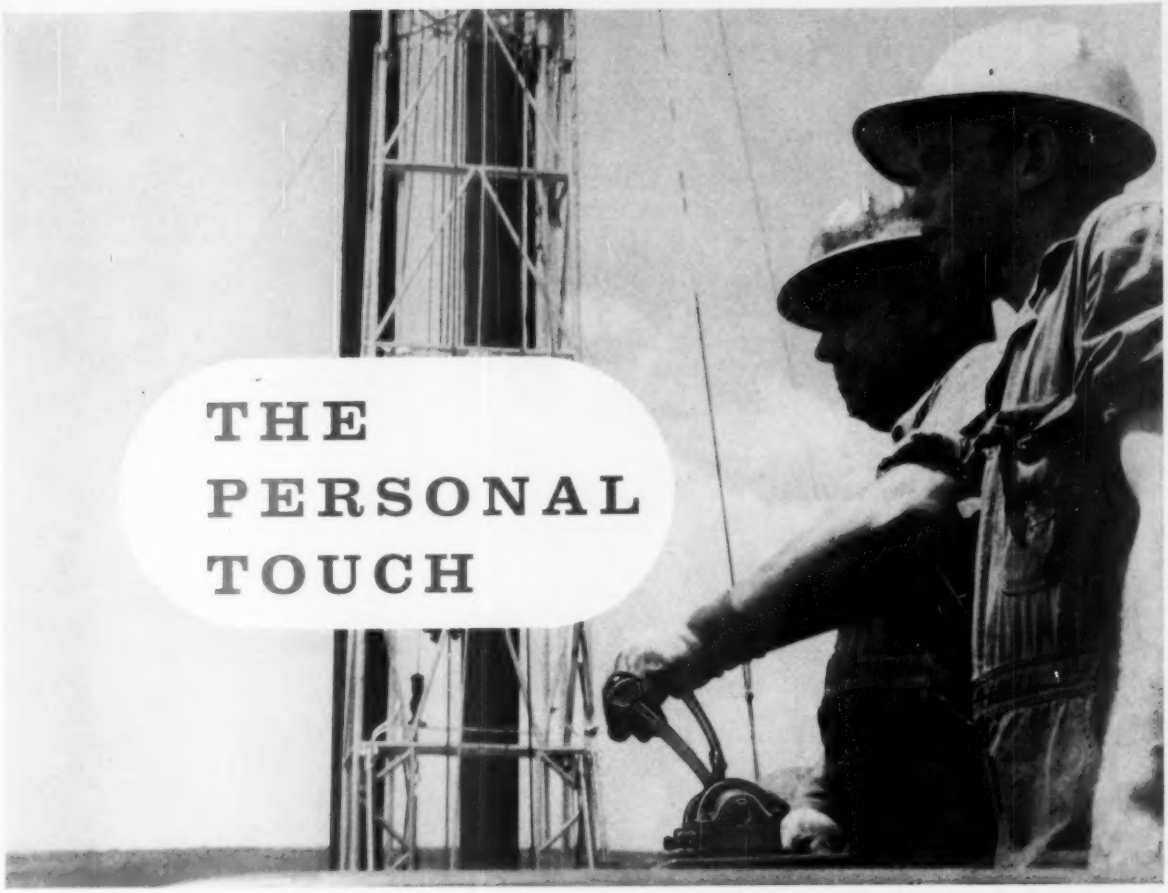
The plant will get its raw materials from Sinclair Refining. Koppers will use or market the output of the plant, expected to total 70,000,000 lb. per year. The decision to build the plant was made at the first meeting of the board of the new company.

Celanese Corp. has taken an option on a 1,000-acre site near Bay City, Tex., 80 miles southwest of Houston. The site is on a proposed barge canal extension from the Colorado River. Celanese has no immediate development plans for the tract.

Also for Refiners . . .

IN THE NEWS: Reserves of crude, natural-gas liquids, and natural gas reach all-time high (p. 71) . . . California Co. puts cost-cutting responsibility on its line supervisors, and the results are excellent (p. 75) . . . Texas cuts back to 9-day allowable in April (p. 76) . . . Import exchanges have been running on basis of 1.06 bbl. of high-priced domestic crude for each barrel of foreign (p. 80) . . .

PLUS THESE TECHNICAL REPORTS: Automatic control with high-speed chromatography (p. 96) . . . WPRA refining quiz on catalytic reforming (p. 116).



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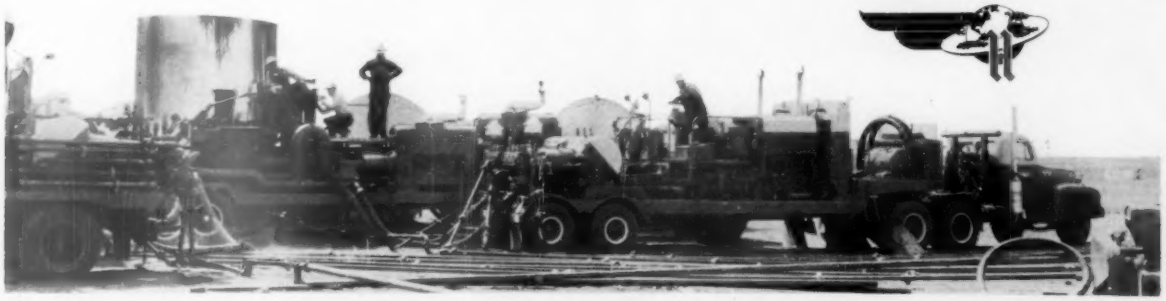

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"FIRST . . . WITH THE FINEST . . . IN FRACTURING"

API Group Seeking Fishing Guide

• Study is aimed at solution to vexing problem: Whether to fish or sidetrack. One survey along Gulf Coast showed break-even point was 10,000 ft.

A COMMITTEE of API's Division of Production is seeking an answer to a problem that has caused years of anguish to drilling men: When do you fish? When is it cheaper to forget a fish and sidetrack the hole?

Very often in the past, drilling contractors and oil companies have found themselves paying more to recover a fish than the fish and the hole were worth. No one had a practical guide to tell them what the odds were against saving money by fishing.

The group undertaking this ambitious assignment is a study committee of API's southern district. The committee held a meeting last week in San Antonio in conjunction with the southern district's annual spring meeting. Chairman of the group is T. B. O'Brien of Gulf Oil Corp., Houston.

O'Brien's group surveyed a large number of oil companies and operators who drill in South Texas and along the Gulf coasts of Louisiana, Texas, and Mississippi. These companies were asked to give details on recent fishing jobs: What caused them? How long they took? and Were they successful?

With the results of almost 200 fishing jobs in hand, the committee has set about drawing averages. The most promising line of attack has been in correlating the depth of the fish with the success of the fishing job. That is, dollar values were put on the drill pipe, collars, etc. in the fish and on the cost of drilling the hole which would have to be abandoned if the fish were sidetracked.

Then the committee took average costs for sidetracking and redrilling at various depths.

From these costs, the dollar value of fish recovered was compared to the costs of recovering the fish.

From one group of wells, it appeared that the break-even point was 10,000 ft. That is, if the bottom of the fish were at 10,000 ft., you had an even chance to save money by fishing. Below 10,000 ft., the odds favored forgetting the fish and sidetracking the hole.

O'Brien pointed out that this 10,000-ft. figure is for the bottom of the fish, not the bottom of the hole. "If there is a lot of open hole below the fish," he said, "you might be able to stretch that break-even point downward."

Another group of wells put the break-even point at about 9,000 ft.

"I'm quite pleased," O'Brien said, "that the two groups of wells came out so close."

He indicated that such an approach might be the final one taken by the study committee.

"We might be able," he said, "to draw up a set of curves so that the contractor or operator could use his own rig costs, etc. Then, he could plug these values into the curves and come up with a good estimate of the chances for a dollar-successful fishing job."

Wall sticking . . . Another topic discussed by the study committee was wall sticking of drill collars. It has been estimated that from 40 to 90% of all fishing jobs that occur while drilling are caused by differential pressure sticking the collars against porous formations.

B. Q. (Jack) Green, Magnet Cove Barium Corp., Houston, described extensive work done by his company.

"Basically," Green said, "the cause of such sticking is that pressure in the hole is higher than it is in the pores of the formation. When the collars lay against the side of the hole, there's a higher pressure working on one side than on the other."

The net effect on the collars is about like that on the plug in the bathtub drain—they're stuck.

There are several ways, Green said, to prevent such sticking or to relieve it after it happens.

First of all, the pressure in the well can be reduced. This was the next effect of a long-time practice of circulating oil after pipe became stuck. Circulating water, if possible, would also help, Green said.

"It helps, too," Green continued, "to reduce the water loss of the muds. I don't know how low water loss can be carried and still make an improvement. But, it's been our experience that when water loss is below 4 cc., there's hardly any tendency at all to stick.

"The quality of solids in modern muds may be the cause of a lot of wall sticking. We don't put in much high-quality clay in our weighted muds. There's little more solid in them than barite and native clay. This creates an undesirable filter cake." Green contended that using high-quality bentonite clays would improve the cake and cut the chances for wall sticking.

Oil in the mud helps prevent wall sticking, Green said.

"Oil alone may not be enough," he continued. "We've had several cases where adding an oil-wetting chemical to a mud already containing oil got the pipe loose."

FPC Member Dies

JOHN B. HUSSEY, 52, Federal Power Commissioner, collapsed and died Thursday while being introduced as a speaker at the Southwest District API meeting. Hussey, who previously has suffered heart trouble, was dead on arrival at a San Antonio hospital.

The newest member of the FPC, Hussey also was considered one of the most well versed commissioners on the oil industry. He resigned as Louisiana commissioner of conservation in June 1958 to accept the presidential appointment to a 5-year term on the FPC. He previously had practiced law in Shreveport, specializing in oil and gas law and taxation.

PIPELINE

A 42-mile 6-in. LPG line is planned by Texas Pipe Line Co. from the New Hope gasoline plant to its Nettleton station in East Texas. The construction contract has not been let. Completion is planned by June.

A 108-mile products line from Union Carbide's Seadrift, Tex., plant to Humble's King Ranch gasoline plant will be built by Seadrift Pipeline Corp., a Union Carbide subsidiary. Pipe Line Technologists, Houston, has the contract for engineering and construction supervision.

A 93-mile construction program of 2 through 30-in. pipe is planned this year by Kansas-Nebraska Natural Gas Co. Kansas-Nebraska will enlarge gathering facilities in Hugoton field,

Paraffin Build-up Prevented

. . . in wells by a new approach to an old problem. A new chemical inhibits deposits on rods and tubing.

OIL PRODUCERS are getting new help in the fight against paraffin deposits which clog wells.

In field tests, this expensive nusiance is being stopped before it starts by a new chemical. The liquid forms a film that inhibits the deposition of paraffin just as corrosion inhibitors do their work.

Previously, remedies for paraffin trouble have concentrated on removing the deposits.

Success of the chemical was disclosed last week by C. F. Parks of Dowell Div. of Dow Chemical Co. before the spring meeting of the southern district of API at San Antonio. Parks cited wells in the Texas Panhandle, the Four-Corners area, and Kansas in which the new treatment was better than older methods.

According to Parks, the inhibitors get to the root of paraffin trouble by oil wetting the metal goods in the wells. Paraffin cannot adhere to such a water-wet film.

The particles are produced with the oil at the surface, where the paraffin can be more readily handled.

To make the paraffin inhibitors effective, the well must first be cleaned of paraffin deposits. This can be done by conventional methods. Then, the rod and tubing strings are cleaned of grease, paint, etc., by a hot degreasing solution which carries the inhibitor.

The paraffin inhibitor is injected into the well periodically.

One of the longest tests of the inhibitor has been in a well in Hutchison County, Texas. Nine months after the new treatment started, the well produced with no evidence of paraffin blockage.

An offset well put on production about the same time had to be pulled because of paraffin after only 73 days. It had had a daily treatment of 1-gal. of conventional paraffin solvent.

To provide a controlled test of the paraffin inhibitor, two wells in Sheridan County, Kans., only 600 yards apart, were used. Both got a thorough cleaning but only one was treated with the inhibitor.

They produced for 7 months when it became necessary to pull the untreated well because of parraffin buikdup. The treated well was pulled and proved to be essentially free of deposits.

Parks said his company has developed several materials which serve well as inhibitors. He did not disclose the price of the materials.

Added Gas Volumes Planned for Midwest

PANHANDLE EASTERN Pipe Line Co. plans to add 400,000 M.c.f. to the daily capacity of its natural-gas system, boosting its total to 1,825,000,000 cu. ft.

James R. Sykes, Panhandle's general sales manager, said the project is "one of the most significant undertakings in Panhandle's 30-year history."

The increased volumes sought in Panhandle's application to the Federal Power Commission would come from two sources: 200,000 M.c.f. daily from expansion of Panhandle's main line and 200,000 M.c.f. daily from expansion of facilities of Trunkline Gas Co., a Panhandle subsidiary. Trunkline filed an application in February for delivery of the additional 200,000 M.c.f. to Panhandle at the Tuscola, Ill., interconnection between the two systems. (OGJ, Feb. 22, p. 74).

The expansion programs will provide for increased volumes to 42 of Panhandle's utility resale customers.

The Panhandle and Trunkline projects would cost approximately $104 million and would include installation of 330 miles of 30-in. pipe and 38 miles of 26-in. pipe. In addition, 300 miles of field gathering lines will be laid and the horsepower of nine compressor stations will be increased.

If it gets FPC approval, Panhandle intends to have the new facilities ready for service during the 1960-1961 heating season.

BRIEFS . . .

build a gathering line near Kimball, Neb., and extend service to several communities. Completion will be by September 1.

Contract for 100 miles of gathering lines for Panhandle Eastern has been awarded to Hall Construction Co., Liberal, Kans. The projects include 28 miles of 4-in., 24 miles of 6-in., 10 miles of 8-in., 12 miles of 10-in., and 26 miles of 12-in., to be completed December 31.

A total of 18 miles of 3 and 4-in. gathering lines is being laid by Banister Construction Co., for Producers Pipelines, Ltd., in East Parkman, Central Hastings, Arlington South Manor, and Steelman fields. They will be completed May 30. Producers expects to complete a 450 hp. unit at Midale station in southeast Saskatchewan.

Work has begun on a 28-mile gas-gathering system near Jonesville, Mich., for Ohio Oil Co. Somerville Construction Co., Ada, Mich., has the contract.

Contract for a 17-mile 16-in. line in West Virginia and a 3½-mile 20-in. line in Greene County, Pennsylvania, has been awarded to Joyce Pipeline Co., Andover, N. Y. The lines are being laid for Equitable Gas Co., with completion due October 31.

Another air base has been connected by a products pipeline to take advantage of economical transportation of high volumes of fuel. Continental Pipe Line Co. laid a 4-mile 4-in. line from Wichita Falls, Tex., to the nearby Sheppard Air Force Base.

Also for Pipeliners . . .

IN THE NEWS: Contracts let for Old Ocean gas line from Texas Gulf Coast to North Texas to supply fuel for power plants (p. 82) . . . Special research team studying problem of weight control for marine pipelines (p. 88) . . . Companies formed to gather Gulf Coast gas (p. 88) . . . FPC lops off 5 cents from gas price in Southern Oklahoma deal (p. 89) . . .

A complete list of pipeline projects is carried in the last issue of each month. Current projects are covered in Pipeline Briefs.

PLUS THIS TECHNICAL REPORT: Pipeliners answer corrosion questions (p. 129).

New Fuels Plan May Get Oil-Industry Approval

• Need for over-all policy would be weighed by a joint committee. There would not be an order to draft a plan or consider allocation of fuels.

MANY SEGMENTS of the oil industry may now drop their opposition to the establishment of a joint congressional committee to study this nation's future fuel and energy picture.

This appeared likely last week after revisions were made in Senate Concurrent Resolution 73 which would create a joint committee.

Virtually all the portions of the original resolution that have been objected to by the oil industry are withdrawn—at least for the time being.

Sen. James E. Murray (D.-Mont.) has prepared the amended version which carefully avoids any mention of possible end-use controls and eliminates other language tending to instruct a committee on what its findings should be.

His new version is being considered by the Senate rules committee and may be cleared to the Senate floor for action. A similar version may also be introduced in the House to replace the older resolution now stymied in the House rules committee.

Major deletions . . . Murray's version makes significant changes in both the text and the tone of the original resolution.

In the first place, instead of instructing the committee to draft a national fuels policy, the new resolution simply directs the committee to "consider the need for formulation of an over-all national fuels policy."

The new resolution also eliminates two key paragraphs which had caused the oil industry a great deal of concern. These specified that the committee should give consideration to:

"The optional allocation of the various fuels and energy resources to their most productive economic uses, including such consideration as the geographic distribution of these resources, and the development of balanced and inter-related regional fuel economies."

And "the desirability of maintaining competition between various energy sources at a level that will promote the national interest by stimulating the development of all fuel and energy industries without excluding any from legitimate markets."

New version . . . As Murray's revised resolution now stands, a joint committee would be instructed to give consideration to:

. . . **"The proved** and predicted availabilities of our national fuel and energy resources in all forms.

. . . **"Projected** national requirements for the utilization of these resources both to meet immediate demands and to provide for future expansion of the economy."

. . . **"Technological developments,** in progress and in prospect, including desirable areas for further exploration and technological research designed to supplement decreasing natural reserves of certain fuels.

. . . **"Governmental programs** and policies now in operation, including not only their effect upon the individual industries so regulated but also their impact upon related and competing fuels and their interaction with other regulatory programs.

. . . **"The need,** if any, for legislation designed to effectuate recommendations in accordance with the above and other relevant considerations . . . "

The tone of the resolution has also been changed considerably by eliminating some of the "whereas" clauses contained in the original resolution.

These deleted clauses contained such flat statements as: "It has become evident that our inevitably increasing fuel and energy requirements . . . cannot be adequately met without a national policy for the effective utilization of these resources . . . "

Other changes . . . In its latest form, the "whereas" phrases are limited to the thesis that adequate supplies of fuel and energy resources in all forms are essential; that this nation's consumption of fuel and energy will increase greatly in the next generation; and that our national reserves of fuel and energy are limited in varying degrees.

The key remaining "whereas" clause is:

"Whereas in view of these and other considerations it appears that a congressional study is desirable to determine if establishment of an over-all national fuels policy is needed . . . "

The proposed joint committee on a national fuels policy would be composed of 8 Senators, appointed by the President of the Senate, and 8 members of the House, chosen by the Speaker.

The move to get such a committee appointed was started by the coal industry, which has made no bones about its feeling that oil and gas have invaded coal's "natural" markets.

Lease Bill May Hike Rentals

CONSIDERABLE progress is being made toward passage of new federal leasing legislation.

The House interior committee has already approved a bill, and the Senate interior committee has scheduled hearings, beginning Wednesday, on another version.

The basic differences between the two at this point are these: The House bill calls for an increase in rental fees while the Senate version does not; and the House bill would increase the acreage limitations in Alaska, whereas the Senate bill would leave the limitations as they are.

Washington observers consider it likely that the House approach is more likely to be adopted, particularly on rental increases, otherwise the legislation would face adamant objections from the Department of Interior.

The basic points of the bill approved by the House committee are:

. . . **Increase** Alaskan leasing limitations from the current 300,000 acres to 600,000 acres. However, the state would be divided into two areas, and the limit would be 300,000 acres in each area.

. . . **Combine** lease and option limitations in all other states, permitting an individual or a company to hold 246,080 acres under lease, and option, of which 200,000 acres could be held under option. Under the present rules, a company can hold only 46,080 under oil and gas lease and 200,000 acres under option.

. . . **Charge** a straight rental of 50 cents an acre. Currently, the rental is 50 cents for the first year, none for the second and third, and 25 cents for the fourth and fifth. If extended for another 5-year period, the rate is 50 cents a year.

. . . **Extend** the term of leases to 10 years, instead of five.

Shell Has Show 35 Miles from Production

ONE of Texas' largest remaining, little-explored inland provinces soon may get its first deep commercial oil or gas discovery.

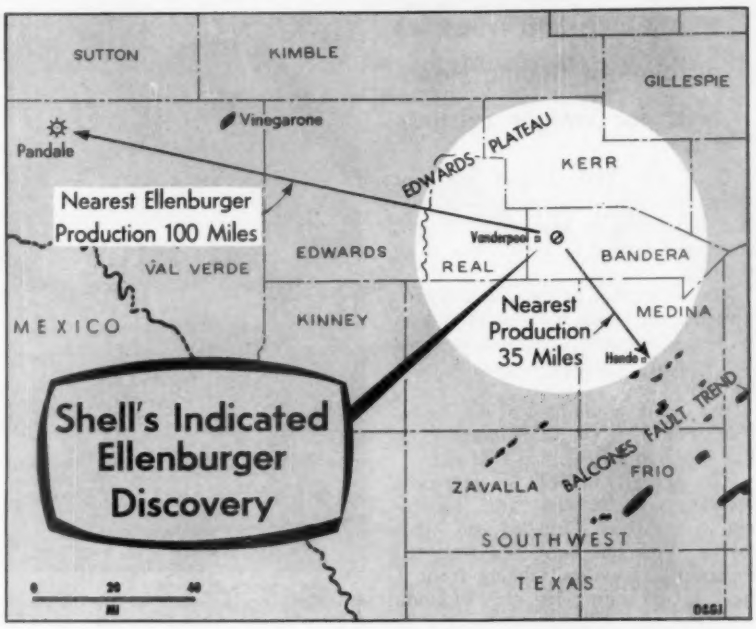
A remote wildcat being drilled by Shell Oil Co. in western Bandera County, in the middle of the vast, wide-open high-land expanses of the Edwards Plateau region, has encountered such favorable gas and oil showings that production seems assured, at least in the vicinity.

Showings are in the Ellenburger formation, prolific Cambro-Ordovician horizon of the West Texas-Southeastern New Mexico area, far to the west and northwest.

Most conclusive indications are in a drill-stem test in 150 ft. of open hole at 8,490-8,640 ft. The test, with tool open 2 hours, recovered 1,300 ft. of gas and 30 ft. of oil-cut mud. Flowing pressures ranged from 920 to 340 psi., top, and 45 to 25 psi., bottom. They indicate a tight, but not impossible, formation.

Hole, contracted to 9,000 ft., currently is being deepened to explore possible lower productive zones. Completion of a well in the above pay will be attempted if nothing more favorable is found.

The well, 1 La Casse, in Section 17, GH & SA Survey, is in the Vanderpool area, 25 miles west of Bandera, and about 10 miles east of the Real county line.



There is no production either in Bandera, Real or Kerr counties, nor in bordering areas of other counties surrounding Bandera County. In the whole Edwards Plateau region there are only a few, scattered small localized pools. Nearest production of any kind is more than 35 miles southwest along Southwest Texas' Balcones Fault trend of fields.

Nearest Ellenburger production is a lone, shut-in 14,000-ft. gas well in the general Pandale area of northwestern Val Verde County.

Methane Firm Moving Abroad

CONCH International Methane, joint Shell - Continental - Union Stock Yards venture and successor to Comstock International Methane, Ltd., will soon be moving its headquarters from New York to London.

There it will set up executive offices with economics, research, patents and other departments.

The move is being made to bring the company closer to its potential scene of operations. England, itself, is its first experimental market and Europe, as a whole, is its largest potential market.

Since the company, when it gets into full-blown operation, will be moving foreign gas to foreign markets, it was the judgment of its officers that a foreign location for its offices would be more advantageous.

Disclosure of the move to London came as the company was winding up its trial shipments of liquefied methane from Lake Charles, La., to Canvey Island, in the Thames River.

The Methane Pioneer is completing its seventh voyage between Lake Charles and Canvey Island.

This pilot operation has been termed an unqualified success. While the Methane Pioneer is too small for long-distance, commercial operations, it did prove that liquefied methane can be transported successfully by sea.

It may go out of service with its final trip, but it will be available for charter.

Entrance of Royal Dutch-Shell into the venture through Canadian Shell, Ltd., has given the company assured sources of supply. This brings it that much closer to commercial operation.

Pan Am Loses Round in Lease Case

A CONTEST by Pan American Petroleum Corp. of the U. S. Bureau of Land Management's authority, to cancel 86 oil and gas leases in Wyoming has been stymied by a technicality.

U. S. District Judge Ewing T. Kerr has ruled in Cheyenne, Wyo., that Interior Secretary Fred Seaton should have been named as a party to the Pan American suit and that the suit should have been filed in federal court at Washington, D. C.

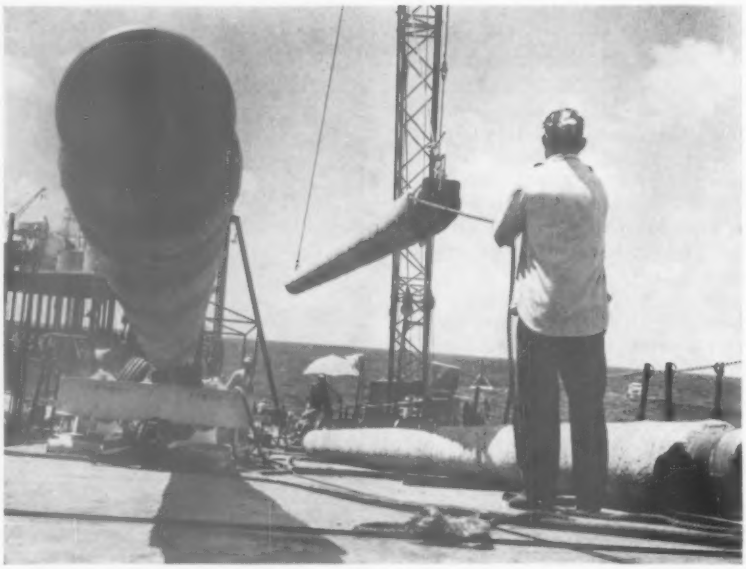
However, Judge Kerr noted that he concurred with the oil company's contention that neither the bureau nor the Secretary, had legal authority to cancel the leases without court action. Pan American says it will appeal the ruling.

Pan American brought the action after the bureau initiated proceedings in the Cheyenne land office to cancel 86 oil and gas leases which it claimed Walter Davis, Casper, held at one time in violation of regulations limiting a person to 46,080 acres of federal oil and gas leases. (OGJ, Feb. 2, 1959, p. 63).

Davis subsequently transferred his leases in much of the land to other companies and individuals.

Pipeliners Hope to Cut Weighting Costs

• ASCE group tackles problem of finding standards for weight coating.



MILLIONS are spent annually on coatings to weight line pipe, but there is still a lot of guess work involved. An ASCE group is seeking a formula which will give pipeliners some standard weight-coating figures.

ONE OF THE largest areas of ignorance—and controversy—in marine pipelining is how much weight coating is needed to keep a line from floating.

The difference of opinion concerns a matter on which millions of dollars is spent annually. Maybe millions are wasted. Pipeline engineers can't be sure.

But a task committee of the American Society of Civil Engineers Pipeline Division is trying to find out.

The weight needed to overcome buoyancy of the pipe varies according to the fluid displaced and other forces. Pipe has been laid weighted to specific gravities ranging from 1 to 2.2, depending on the situation and company policy.

One company may apply little or no weight coating—concrete, cast iron, or other materials—to a pipeline laid along a route where another has applied a heavy jacket. Who is right?

The correct answer could be the means of saving millions of dollars a year. And the matter becomes more important as pipelines are laid to an increasing extent in the Gulf of Mexico, coastal marshes, and across lakes and rivers.

The problem ... Raymond H. Crowe, chief engineer, Transcontinental Gas Pipe Line Corp., summarized the problem well at the New Orleans ASCE Pipeline Division meeting.

"Pipeline engineers know that they must make provisions to overcome buoyancy of pipelines where it exists, but do not know how to accurately calculate the buoyant forces except in a few isolated cases," Crowe said.

"We are apparently spending about $15 million annually on a design basis of sheer guessing. I can think of no other phase of the pipeline industry where a like amount of money is spent without a reasonably accurate design calculation."

The complication . . . It is simple enough to compute buoyancy and the weight needed to counteract buoyancy in water. But there's a hitch: Most pipe isn't laid in water alone; it's usually laid in a ditch in mud, slurry, or silt.

"The big question," Crowe points out, "is whether this material is a fluid, and if so, is it always a fluid or does it consolidate and become a solid.

This point was brought home recently to a major gas line. Long stretches of what was normally dry land became swamp, and the pipe, being unweighted, floated to the surface. It had to be weighted and buried again at considerable cost.

Dollars and cents . . . New lakes that are being built all over the country cause the same problem.

On the Transco system a power company is building a lake that will flood 5 miles of its parallel 30 and 36-in. lines. To boost the specific gravity of each line to 1.15 would cost $300,000 for concrete weights.

But is that outlay necessary? Is it enough? Is it too much? What tests will answer these questions?

"If the ASCE task committee could provide answers that would save even half of the $300,000, it would seem to me to be a valuable contribution."

In another situation, Transco's studies show how much is at stake in efforts to find precise answers as to how much to weight marine lines. The company estimated that the cost of laying a 24-in. line in swamp with specific gravity of 1.25 compared to a specific gravity of 1 would be an added $14,000 per mile. On a 50-mile line, the difference in design amounted to $700,000.

Crowe estimated that his company could wisely spend $10,000 on tests to help pinpoint weight requirements on a project of that size and cost.

Gas Company Formed to Supply TGT

TWO companies have joined to gather sizable reserves of South Texas gas for delivery to Tennessee Gas Transmission Co.

Gulf Resources, Inc., and Natural Gas Gathering Co., Inc., a subsidiary of Delhi Taylor Oil Corp., Dallas, have filed for Federal Power Commission approval of the project.

The project includes a 31-mile gathering system of 10, 12, and 14-in. pipe to deliver 70,000,000 cu. ft. daily to Tennessee in Zim field, Starr County. The system will be operated by Natural Gas Gathering.

Gas will come from Juan Grande, Davey Crockett, Lopeno, and Northeast Lopeno fields in Zapata County, and El Puerto field in Starr County. Principal producers are Jonnell Gas Co., Atlantic Refining Co., Gulf Oil Corp., and several independents. Production is from Wilcox zones at 7,500-11,000 ft.

Debate on U. S. Tanker Proposal Flares Again

• Backers of the plan to require shipping of half of all oil imports in American flag ships say it is a defense measure. The other side tags it as a subsidy for a small group of speculators and latecomers.

ARGUMENTS for and against a proposed requirement that 50% of imported oil be hauled in U. S. flag tankers are now being filed with the Office of Civil and Defense Mobilization.

Sponsors of the proposal—the Joint Committee for American Flag Tankers and the Committee of American Tanker Owners, Inc.—say the step is necessary because U. S. flag tankers cannot compete with foreign-flag fleets and therefore are in danger of going out of business, and this, they say, would weaken this nation's defense position.

The Texas Independent Producers and Royalty Owners Association is supporting this approach on the basis that increased shipping costs would narrow the gap between the cost of foreign and domestic oil and thus help strengthen the domestic oil industry.

In a statement filed with OCDM, TIPRO said that "excessive" use of foreign-flag tankers "is one of the major factors responsible for domestic oil's continuing distress."

Protests . . . Sharp objection to these views has been taken by several major oil companies, including Gulf Oil Corp. and Standard Oil Co. (N. J.)

In addition, the International Chamber of Commerce has objected, and it is considered likely that government agencies, including the Departments of State, Interior, and Defense also will oppose the restrictive plan.

Both Gulf and Jersey Standard pointed out that the tanker committees sponsoring the 50% plan actually represent only a very small part of the tanker industry.

"Many of those expressing concern over the future of the American flag tankers are speculators who entered the U. S. shipping picture during the Suez crisis with the hope of large profits," Gulf said in its statement filed with the OCDM.

Gulf also said: "The shipowners represented by the Joint Committee for American Flag Tankers operate but 3% of the U. S. flag tanker fleet, and proposals advanced by that committee are designed solely for the protection of these latecomers."

The Committee of American Flag Tanker Owners, Gulf said, represents only about 9% of the privately-owned American tanker fleet.

Jersey Standard maintained the adoption of the 50% proposal would reduce tanker tonnage under control of the U. S.; establish an "unfortunate" precedent for further discriminatory action by other nations; impose an unnecessary and onerous burden on U. S. petroleum consumers through increasing costs; and force unreasonable financial losses on companies with long-term commitments for oil importation.

"What is being proposed," Jersey said, "is simply a subsidy for a small group . . . "

Gas Price Is Cut 5 Cents

. . . in deal for southern Oklahoma reserves. Producers will ask full commission to reinstate contract price.

A FEDERAL Power Commission examiner has again wielded the "CATC ax" to lop 5 cents an M.c.f. off the proposed 16-cent contract price for a sale of southern Oklahoma gas to Natural Gas Pipeline Co. of America.

Examiner William J. Costello at the same time recommended a permanent certificate for sale of North Texas gas to Natural at the contract price of 13 cents, which was said to be in line with other prices in the area.

The Oklahoma producers immediately announced plans to appeal to the full commission to reinstate the initial contract price.

The ruling was the latest evidence of FPC's thinking growing out of the Supreme Court decision in the CATC case. The court decreed that FPC must determine whether an initial price is supported by substantial evidence to show it is required by the public convenience and necessity.

Since that decision the Supreme Court has ordered FPC to reconsider a ruling approving 22.4 and 23.3-cent prices for Transcontinental Gas Pipe Line Corp. (OGJ, Dec. 21, 1959, p. 47). And last month the commission reduced from 20 to 17.7 cents the price which El Paso Natural Gas Co. may pay to producers in Aneth field, Utah (OGJ, Feb. 29, p. 52).

New producer setback . . . The FPC examiner's latest price ruling came as he recommended a permanent certificate for Natural's $62,563,000 expansion bringing an added 185,000 M.c.f. daily to Chicago.

The project has actually been completed and operating more than a year under temporary authority.

A reduction to 11 cents an M.c.f. was recommended on sales from South Rainey, Chitwood, and West Cement fields, in southern Oklahoma. Producers involved are Amerada Petroleum Corp., Magnolia Petroleum Co. (now Mobil Oil), Anson L. Clark, Cornell Oil Co., Pure Oil Co., Gulf Oil Corp., Riddell Petroleum Corp., and Fain-Porter Drilling Corp.

The examiner said that the producers introduced no evidence of the cost of producing the gas to justify the 16-cent contract price. He found the "existing area price" (as distinguished from the "going price") to be 11 cents.

Noting the previously certificated sale of gas from nearby Carter-Knox field to Lone Star Gas Co. and Oklahoma Natural Gas Co. at 16 cents an M.c.f., Costello called the deal "a 16.8-cent island in predominantly an 11-cent sea."

Producer arguments . . . Producers accused him of ignoring the general increase to the 16.8-cent level in gas prices paid by Lone Star and Oklahoma Natural after the Carter-Knox purchase and prices well above 11 cents.

Oklahoma Natural originally objected to the 16-cent sale to Natural Gas Pipe on grounds ONG and Lone Star were paying only 11 cents.

Producers contend that the record in the Carter-Knox case shows that Oklahoma Natural, together with Lone Star, was negotiating for Carter-Knox gas at a price approximating 16.8 cents at the time ONG intervened in the Natural Gas Pipe case.

THE GLEAMING NEW 135,000-bbl. Ciudad Madero refinery is just part of a big building program going on in Mexico.

Pemex: Booming Bureau with Big Plans

• It has a budget of 8 billion pesos this year, almost as much as the rest of the entire national government. It's expanding in all directions, with this goal: Get the energy to support an exploding population.

George H. Weber
Editor

LAST FRIDAY Mexico celebrated its twenty-second and possibly its most significant anniversary of oil expropriation. For the occasion, President Adolfo Lopez Mateos went to Tampico to dedicate state-owned Petroleos Mexicanos' largest and newest refinery.

The time and the place were highly significant for that city looms important in Mexico's past, and in her future.

Tampico is rich in oil history. During the first quarter of the century, the prolific production of nearby Panuco and the Golden Lane surged through its river port. Much of this oil was processed in three privately owned refineries on the city's waterfront.

These ancient refineries still stand—but they won't for long. As the expansive 135,000-bbl. Ciudad Madero refinery goes on stream, operators are cutting the fires under the old stills which it will replace.

The fire is also going out of Mexico's "18 de Marzo" celebration. It has become by design a quieter, more dignified occasion, emphasizing the future which promises better international relations for Mexico's monolithic oil company.

Pemex is mounting a massive muscle-building program with the aid of sizeable new foreign credits. For the first time in its history, the company is receiving a transfusion of new capital. And American techniques and equipment for exploration, drilling, pipelining, and refining are going far in helping Mexico to help herself.

Mexico is now reversing a decline in her gross national product. A new industrial revolution appears ready to sweep the country. It will need energy in quantities never before dreamed of. And Pemex, as the sole supplier of gas and oil, has its job cut out for it.

The $127,800,000 in foreign loans negotiated last year by Pascual Guiterrez Roldan, Pemex director general, has given the company a shot in the arm. With it, Pemex is literally exploding in all divisions. New capital expenditures now committed and planned total $377,640,000. They will be met with foreign loans, new Mexican capital from bankers, private investors, and the government, and with 3 to 10-year credits granted on American and European equipment bought by Pemex.

Pemex' ambitious plans for the long-range future may require further capital from beyond its borders. But the company hopes that its new breakthrough in operations will provide most, if not all, of the billions of pesos required.

The company has lost no time in getting its program under way. It is off and running on the following fronts:

... **Drilling** will nearly double in 1960. This year alone, Pemex is investing $17½ million in exploration, drilling, producing, and marine equipment.

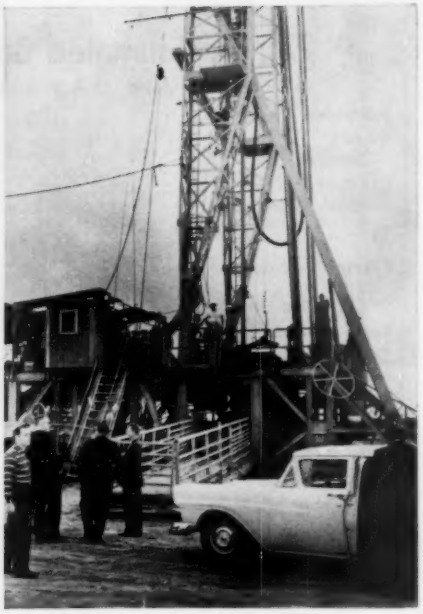
... **Refinery construction** now under way or committed will add 50% to crude capacity, at the same time retiring the three old, uneconomic plants.

... **Petrochemicals,** practically nonexistent a year ago, will feed the nation's economy from 17 new plants costing $112 million. Three of these plants are on stream.

... **A new gas pipeline** network linking production in the north and south with all of Mexico's important industrial centers is now under way and projected.

... **New crude oil** and product lines are going in to serve the expanding refinery program.

LUBES also figure in Pemex' expansion plans.



DRILLING will nearly double in 1960.

... **Distribution centers** are being established to serve all of the nation, except the extreme northwest where U. S. imports are still feasible.

Drilling contractors busy . . . A new concept of drilling efficiency has hit Mexico.

Modern diesel rigs are fast replacing the old steam units. More important, a new contracting industry is now rigging up. The first break in Pemex' drilling monopoly was begun under the regime of Antonio J. Bermudez. It has been actively promoted by his successor.

Director General Gutierrez Roldan is encouraging new contractors by giving them all the development wells they can handle. Pemex still drills its own wildcats, except offshore.

Contractors, with 38 drilling rigs vs. Pemex' 96, are profiting by this new arrangement. They can attract skilled men from Pemex, with its blessing, by offering bonuses for performance. Their problem seems to be capital.

Eventually, some Pemex observers believe that the company will get out of the drilling business entirely and contract all of its work.

Temporary refining excess . . . For the present, Pemex refineries are running full to meet demand. But 240,000 bbl. per day in new capacity is now coming on stream or contracted. This new capacity in four refineries will retire 103,700 bbl. per day in four old plants and add 50% to Mexico's present 270,000 bbl. per day throughput.

In leapfrogging demand, Pemex will work with an excess capacity for a short time. It is negotiating with foreign interests for possible custom processing contracts, to be handled in the new 135,000-bbl. Ciudad Madero plant near Tampico. If successful, Mexico will probably process some Latin American crude for Latin American markets.

Major Construction Projects

(Millions of U. S. Dollars)

	Under way	Planned
Field processing	7.04	5.04
Refineries	15.60	13.76
Distribution plants	1.12	8.24
Gas Pipelines	19.12	14.00
Products Pipelines	0.48	8.48
Docks	0.88	.....
Petrochemical plants	28.80	17.60
Other installations	5.44	13.04
TOTAL	**78.48**	**80.16**

Pemex is investing heavily in downstream processing—cat cracking, alkylation, polymerization, hydrotreating, and lube manufacture. But it still plans no catalytic reforming, except for aromatic petrochemicals.

As a state monopoly, Pemex has its problems. But marketing is not one of them. Its octane policy is governed not by competitive pressures, nor even by consumer demand, but by the company's ability to make and deliver uniform grades at uniform prices to private distributors throughout Mexico.

By U. S. standards, octanes are low. Super Mexolina, accounting for an overwhelming 93% of volume, rates 80 Research octane. The other grade, 90-octane Gasolmex, is available through much of the country, but its popularity is limited.

The overwhelming majority of cars in Mexico are satisfied with these grades. Most motorists drive in the high interior plateau where they gain a substantial altitude bonus on octanes. As a result, many motorists could get by with even lower octanes than Pemex now provides.

The former third-grade Mexolina was very popular, particularly with drivers of older cars. But Pemex is now in the final stages of withdrawing this 70-octane grade from the market—not without protest. It sold for about 55 centavos per liter (15c/gal. U. S.) vs. 80 centavos for Super Mexolina and about a peso for Gasolmex.

In phasing out this lower third grade, Pemex raised its quality and substantially improved its income. Three plans are now under consideration for further progress. One calls for wider distribution of Gasolmex which should improve its demand, particularly in the coastal areas where even Super Mexolina knocks badly in new cars.

Another plan contemplates boosting the two remaining grades to 82 and 95 octane. Still another visualizes a third grade of 95 octane or higher. It is likely that the first plan will be followed at least for the near future.

Gas on the go . . . The 1960 gas pipeline budget of 750 million pesos is five to six times larger than last year's.

Biggest item is the 500-mile 24-in. line from Ciudad Pemex feeding Jose

Pemex' Estimated Budget for 1960

(All figures in pesos. One U. S. dollar equals 12½ pesos)

Estimated Income	
Sales	
Domestic	$5,773,074,800.00
Export	340,000,000.00
Other income	24,000,000.00
	$6,137,074,800.00
Foreign and domestic loans	1,657,649,000.00
Total income	$7,794,723,800.00
Expenditures	
Operational	
Normal expenses	$1,715,691,804.00
Extraordinary expenses	627,082,285.00
Accessories and services	1,225,978,000.00
Purchase of equipment & materials for resale	133,809,072.00
Contract drilling	354,798,314.00
	$4,057,359,475.00
Liabilities	
Repayment to investment bankers	$ 322,081,338.00
Repayment to private creditors	342,621,966.00
	$ 664,703,304.00
Federal government	
Interest on permanent credits	$ 143,981,009.00
Taxes	736,448,976.00
	$ 880,429,985.00
Capital Expenditures	
Replacement of major & minor installations	$ 192,086,555.00
Equipment replacements and purchases	218,939,600.00
Miscellaneous new projects	1,785,254,000.00
	$2,196,280,155.00
Contingent Expenses	21,000,000.00
GRAND TOTAL	**$7,819,772,919.00**
Deficit	$ 25,049,119.00

Colomo and other Isthmus gas to Mexico City. This line, plus an extension to Salamanca, will be in operation late this year. In the north, the network tying Reynosa to Monterrey and Saltillo is reaching out to Torreon and Chihuahua.

Future projects to cost an additional 500 million pesos will tie Mexico's gas sources in Reynosa, Poza Rica, and Tabasco to every major industrial city in the country.

Little of this gas will be used in private homes. Industry has first call, and Pemex forsees difficulty in keeping up with its mounting energy appetite. For example, the Ciudad Pemex-Mexico City line is scheduled for continuous expansion through addition of compressor stations. Before this line has reached its ultimate capacity, it is anticipated that another will be required to serve the sugar-producing area lying between Tabasco and Mexico City.

This explosion in gas demand and delivery will take some pressure off of crude production. The Mexico City line, for example, will back out the equivalent of about 50,000 bbl. per day of crude which can be used to meet Mexico City's gasoline demand, which is rising 12% per year.

The entry of gas will also free additional supplies of heavy fuel oil available for export. Watch for new competition in world markets on this commodity.

Petrochemicals . . . Altogether, 14 new plants are under way or committed, to give Pemex a fast start in the petrochemical business.

Pemex will confine itself to the basics, retaining full control of such building blocks as ammonia, dodecylbenzene, aromatics, carbon black, butadiene, ethylene, and sulfur. Intermediates and finished products will be made by private interests, many of them with American participation.

The combined budget for basic petrochemicals totals 1,395 million pesos, or $112 million. The entire amount is expected to be amortized in 3 to 5 years. This program will give Pemex a spurt in income, much needed to carry out later projects in both chemicals and oil. Pemex officials have found that demand has exceeded their fondest hopes in the few petrochemical ventures they have launched thus far. The same reception is anticipated for the new plants.

If its new capacity does prove to exceed domestic demand at the outset, however, Pemex plans to export petrochemical basics to the U. S. and elsewhere in Latin America. This is not a likely prospect.

Welcome private enterprise . . . Pemex is running the show on oil and gas and basic petrochemicals. But its directors are frank in expressing their need and their desire for aid from private contractors, service companies, and equipment manufacturers.

The rules call for this auxiliary industry to have a strong Mexican flavor, however.

In plant construction, private contractors also have an important role. Pemex is doing some of its own refinery construction through a major projects division. But in the case of the giant Madero refinery dedicated last week, about 80% of the work was subcontracted by Pemex. Some refinery projects, like Salamanca, are being handled by American companies, using a maximum of skilled national labor.

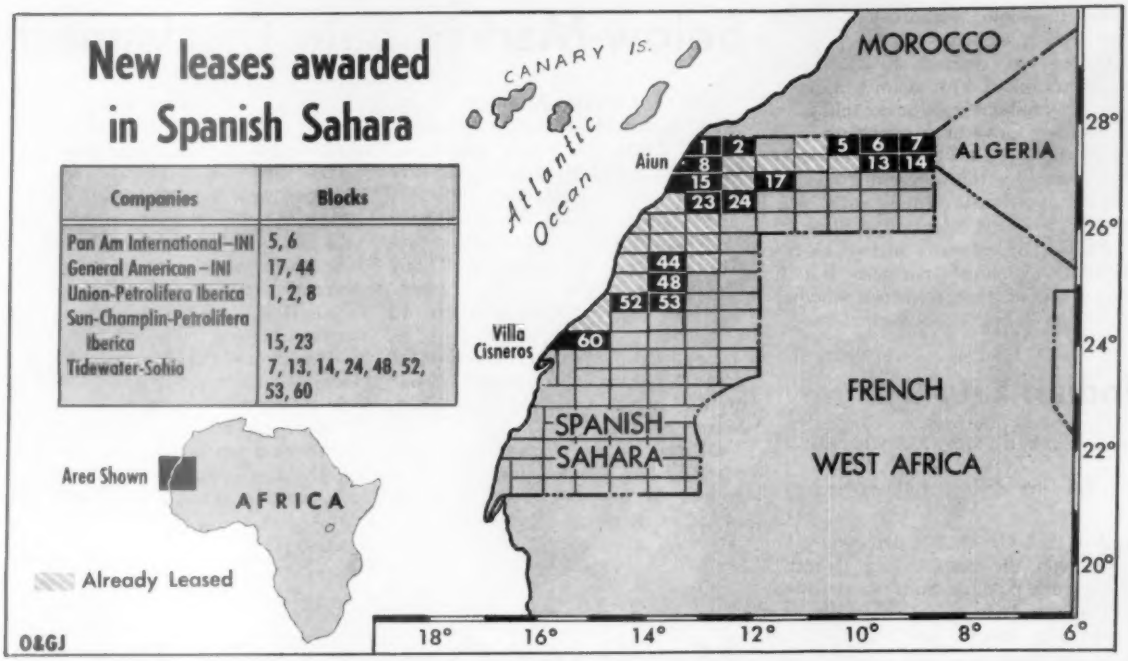
The government is actively encouraging American and other foreign firms to establish Mexican affiliates to manufacture oil equipment. Drilling equipment, tanks, heat exchangers, and other major equipment items are now being made or soon will be produced in Mexican plants. They will have first crack at the Pemex market.

Much equipment still must be imported, of course. In selecting between American and European equipment, one Pemex official stated that he would personally select American equipment whenever prices were comparable, or even if U. S. prices were 10% higher.

Mexico represents a strong potential market for American equipment and knowhow. One needs to look closely to distinguish many Pemex operations from similar ones north of the border. Field processing plants, refineries, and drilling rigs — and their operations, have a distinctly Yankee flavor.

Efficiency is a watchword today, from Pemex top officials, down to the very able young engineers in the fields and plants. As Director General Gutierrez Roldan stated recently, Pemex is expanding and modernizing with the help of U. S. technology.

"You have taught us how to make progress," he said. "We are still learning from you."



More Awards Made in Spanish Sahara

• Tidewater and Sohio are the big acreage winners in the latest round of leasing. And they plan to start exploration work immediately. All together, five groups won rights on 17 blocks. Other bids are still under study.

TEN COMPANIES or groups have now won a total of 35 concession blocks in the Spanish Sahara. At least one operator plans to start exploration work immediately.

The successful bidders for acreage in the Spanish colony on the northwest coast of Africa were either American firms or Spanish firms in partnership with U. S. companies.

The Spanish Government has made the awards under a new oil law passed last year. Concessions vary in size, but average about 600,000 acres each. Decision on bids for 11 more blocks still is pending.

Tidewater program . . . Exploration work will start immediately on eight licenses pooled by Tidewater Oil Co. and Standard Oil Co. (Ohio).

Tidewater will be the operator on the permits, which cover about 5 million acres. The acreage extends from the border of Algeria southwestward to the Atlantic coast.

The company plans to establish a base of operations at Las Palmas, in the Canary Islands 120 miles off the African mainland.

In addition to the Sahara blocks, Tidewater and Sohio also have obtained a permit in the southwestern part of the Spanish mainland.

Previous leases . . . The first awards in the Sahara were made to five groups of American companies and comprised 18 blocks totaling about 11 million acres (OGJ. Feb. 15, p. 78).

Those winners and the blocks granted are: Gulf-CEPSA, 9, 10, 16, 47, 51; Cities Service-Richfield-CAMPSA, 30, 39, 40, 43; Caltex, 22, 31, 32, 41, 45, 57; Phillips, 4, 11; and Atlantic Refining, 12.

Spanish partners . . . The oil law does not obligate foreign companies to operate jointly with Spanish partners. But in most, if not all, cases the offers by companies included or made room for participation by private or government organizations.

In most cases the partnerships are with the government itself, or with companies that are major factors in Spanish refining and marketing.

Instituto Nacional de Industria (INI) is a government company in partnership with Pan American on two blocks, and with General American on two blocks. It has 52% interest in the 84,000-bbl, refinery on the Canary Islands, and has 24% interest in the Escombraras plant.

CEPSA supplies products to Cia. Arrendataria del Monopolio de Petroleos, S. A. (CAMPSA), which handles the government's marketing monopoly. Owned jointly by private interests and the government, CAMPSA operates the government monopoly in return for a 4% return on its capital, and a 2½% commission on sales.

CAMPSA itself has an interest in four blocks, with Richfield and Cities Service as partners.

Petrolifera Iberica, a local exploration company that has worked in Spain for years with a German firm, Schachtbau, has entered the Saharan play in two separate deals. It is a partner of Union Oil on two blocks, and of Sun Oil and Champlin on two blocks.

Bids made by some companies leaves the door open to participation by Spanish interests. Atlantic Refining will give 20% in its one block to any Spanish company willing to meet the cost.

A Spanish bank, Uriquijo, has an option to take 20% interest in the

Tidewater-Sohio venture after the first well is drilled.

Caltex has offered 40% interest in its six blocks to Spanish capital. The government can select either a private or government organization as partner. Caltex is the only foreign company that presently has an interest in Spanish refining, with 24% interest in the Escombraras plant.

Phillips Petroleum won two blocks without a Spanish partner. But it was not immediately learned whether it will have Spanish participation.

Indian Crude Line

. . . will be completed in '61 to Nunmati refinery.

A WEST GERMAN company may have won the construction contract for a crude pipeline from Nahorkatiya to Gauhati, India.

Industry reports say the German firm, Mannesmann, will lay the 260-mile 16-in. system for Oil India Private, Ltd., owned two-thirds by Burmah Oil Co. and one-third by the Indian Government.

The line is scheduled for completion in March 1961. It will carry crude from Nahorkatiya and Moran fields in northeastern India to a refinery at Nunmati, a village near Gauhati, India.

Stewarts & Lloyds, London, is supplying 32,000 tons of pipe for the project. The final deliveries are expected to reach India this month.

A contract for 14-in. pipe for the second, 460-mile section of the system has been awarded by Oil India to Hindustan Steel Ltd. Mannesmann is building a steel mill at Rourkala for the company. The plant will open in September. The extension will run from Nunmati to a refinery at Barauni.

Burmah Oil Co. (Pipeline), Ltd., a wholly owned subsidiary of Burmah Oil, has charge of the route survey, engineering in connection with the route, and general design of the line. The system is expected to cost about $112 million.

The pipeline will be buried at a depth of at least 6 ft. over its entire length, except at bridge crossings. There will be a total of 77 river crossings. The most difficult will be a crossing of the Brahmaputra River, where precautions must be taken against possible changes in the channel during monsoon seasons.

The system will permit an increase in Indian production from the present 8,500 bbl. daily to 65,000 bbl. daily (OGJ, Mar. 14, p. 118).

Below-Market Sale Disclaimed

SAN JACINTO Petroleum Corp. last week denied any part in the below-market crude sale which has drawn the public ire of Venezuela's ministry of mines and hydrocarbons.

Dr. Juan Pablo Perez Alfonso singled out three Lake Maracaibo producers by name as having sold 577,000 bbl. of oil to a New Jersey "in bond" refinery at prices from $1.50 to $2 a barrel.

He vowed he will put a stop to the practice. He named San Jacinto as one of the offending companies (OGJ, March 14, p. 117).

Officers of San Jacinto say this is not so. "San Jacinto never sold nor offered to sell any crude to Interamerican Refining directly or indirectly and has had no connection of any sort with the transaction in question," a San Jacinto spokesman said.

The company official went on to point out that San Jacinto is the operator of Block 575 on the eastern edge of Lake Maracaibo for itself and six other companies. But each of the seven partners "is responsible for and handles it own crude sales," the spokesman said.

The minister's reference to San Jacinto apparently resulted from a sale by another member of the group.

Mene Grande Lago, the 21-well field which San Jacinto has developed on the small block of lake acreage, produces an average of 34,800 bbl. daily.

Mexicans Clarify Latin Trip

THE RECENT visit of Mexican oil officials to other Latin American countries has been misinterpreted, according to Pascual Gutierrez Roldan, director general of Mexico's government-owned Petroleos Mexicanos.

Pemex officials have been accused of offering technical aid to Venezuela in helping the country develop a national oil company. This is not the case, said Gutierrez Roldan in a statement to The Oil and Gas Journal.

"The Venezuelan authorities extended invitations to Petroleos Mexicanos to send a group of their top technical men for a short visit while the President of Mexico was in Venezuela at the beginning of his recent South American tour," Gutierrez Roldan said.

"The purpose in mind was to get acquainted with conditions and developments in the various technical and economical aspects of the Venezuelan oil industry."

The Mexicans particularly were interested in Venezuela's petrochemical and refining industries and discussed the possibilities of "trade agreements of mutual benefit for both countries."

"In no occasion whatsoever did the Mexican officials or technical men recommend to the Venezuelan officers any measures or policies regarding oil or any other economical field," Gutierrez Roldan said.

He said Mexican President Adolfo Lopez Mateos made it clear Pemex officials were to be "scrupulously respectful of national policies and decisions which should be determined by each nation in its own interest and as a privilege derived from its sovereign rights."

"The Mexican oil mission was glad to cooperate with Venezuela by answering questions related to experience acquired in 21 years of national administration of the Mexican oil and gas resources, mainly in the fields of industrial planning and execution of programs.

"No political issues were discussed and the conversations were exclusively limited to technical and economical subjects."

Gas Line Set for Colombia

TWO COMPANIES are teaming up with private Colombian interests to build the country's first natural gas pipeline.

Mobil International and Texaco, through their jointly owned affiliate Colombian Petroleum Co., will help build a 140-mile 10-in. gas line from their 4-year-old Cicuco oil field to the Caribbean seaport of Barranquilla. The line will initially deliver 20 million cubic feet daily to industrial customers when it opens late next year.

The $7 million project will be built and operated by Gasee Naturales de Colombia S. A., in which Colpet holds half interest. Local Colombian interests hold the remaining 50%. It marks the first time in South America that U. S. companies have joined with local private capital on a natural-gas project.

For economical pumping choose from these Bethlehem rods

These four types of Bethlehem sucker rods will handle a wide range of pumping conditions. Each rod is carefully made and thoroughly inspected, and can be counted on to keep strings in the hole for long periods of time. If you have any question about the use of these rods, or about Bethlehem's full line of sucker rod accessories, get in touch with your Bethlehem sucker-rod distributor. Or, if you prefer, the nearest Bethlehem sales office will gladly give you full details.

ROD	TYPE	HEAT TREATMENT	YIELD POINT psi		TENSILE STRENGTH psi	
			Min.	Av.	Min.	Av.
X 2	Carbon-manganese	Normalized	65,000	72,000	93,000	100,000
X Mayari	Nickel-chromium	Normalized	60,000	65,000	90,000	95,000
46	Nickel-molybdenum	Normalized and tempered	67,000	75,000	82,000	90,000
43	Nickel-chromium-molybdenum	Normalized and tempered	100,000	110,000	120,000	130,000

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

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Automatic control with high-speed chromatography

New control instrument suited for fractionator and absorber control

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R. E. WIGHTMAN
Phillips Petroleum Co.

A NEW high-speed chromatographic analyzer, designed specifically for process control, has operated successfully in commercial closed-loop control systems. The analyzer has improved control substantially on a natural-gas-liquids depropanizer and also on a furfural absorber.

Automatic chromatographic control of these columns saves utilities by permitting the operator to drive the column only as hard as necessary to maintain minimum product specifications. Too, the maximum inclusion of less-valuable components in the finished product makes more of the valuable components available for sale, and thus provides for incremental increase in production.

The new analyzer operates on cycles of a minute or less. It provides a continuous output signal corresponding to the measurement of the key component in the process stream.

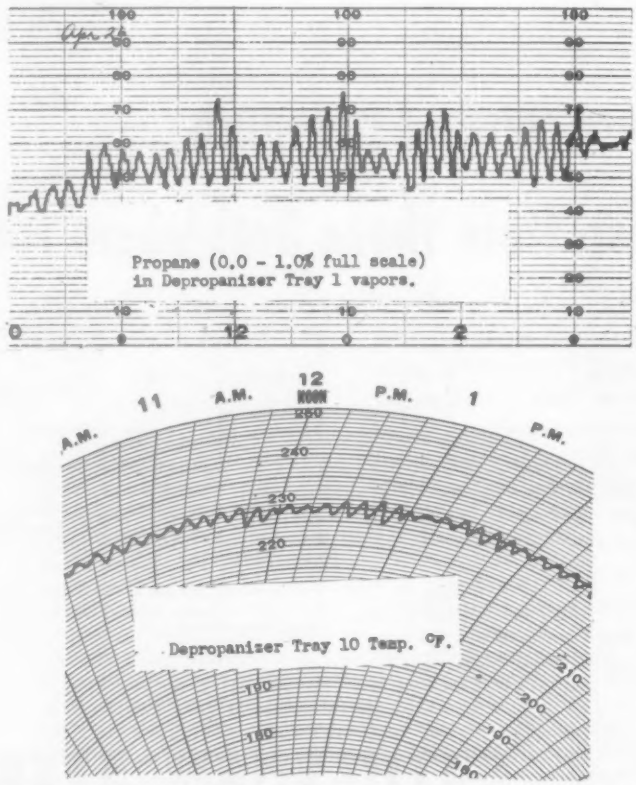
The analyzer section is a commercially available model in which the sampling valve, motor detector, and column have been replaced by two pneumatically operated valves, compatible columns, and detector. These new components permit complete separation with high sensitivity of methane, ethane, propane, isobutane, and normal butane in less than 50 seconds of elapsed time, even when the sample contains pentanes and heavier.

The analyzer column can be tailored to measure a specific hydrocarbon on a much faster cycle, e.g., ethane in propane and heavier hydrocarbons can be measured on a 20-second cycle. Such a selection makes possible a 1-minute analysis cycle for determining the sum of the butene-1, isobutylene content in a stream containing butadiene and cis and trans-butene-2.

A special programer operates the analyzer section. Designed specifically for high-speed analysis and process control, it performs all the functions of a standard chromatographic programer for measuring a single component. In addition, it provides a continuous signal corresponding to the peak height of the component being measured. This signal, properly transduced, is suitable for control purposes.

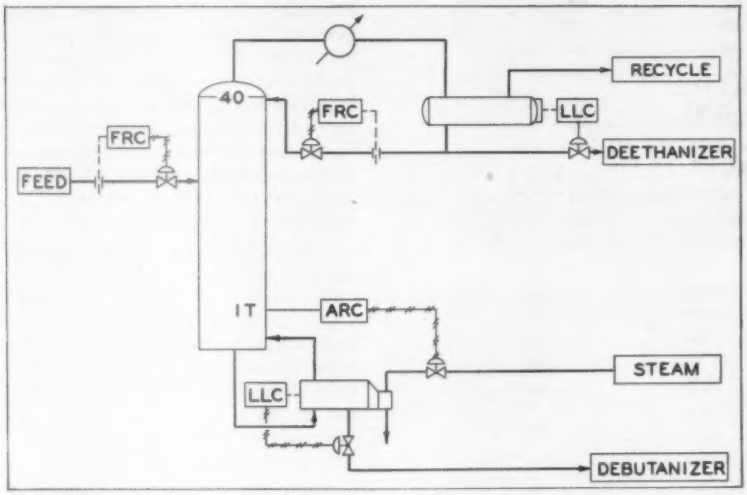
In operation, sample flows continuously through the analyzer. At a signal from the programer, a measured volume of sample is flushed into the chromatographic column. All the components in the sample, except the one for which the programer is gated, are ignored. When the key component arrives at the detector, the resulting signal is measured, amplified, and stored until the next cycle when the sequence is repeated. The stored signal is a steady, continuous output signal analogous to the amount of the key component present.

This high-speed chromatographic analyzer, with its short analysis cycles and continuous output signal, thus qualifies as a process-control instrument suited for fractionator and absorber control.



EFFECT OF DEPROPANIZER oscillation on propane concentration in tray 1 vapors (top) and on temperature (bottom) on tray 10. Period is approximately 8 minutes. Fig. 1.

Paper presented at WPRA meeting, Casper, Wyo.

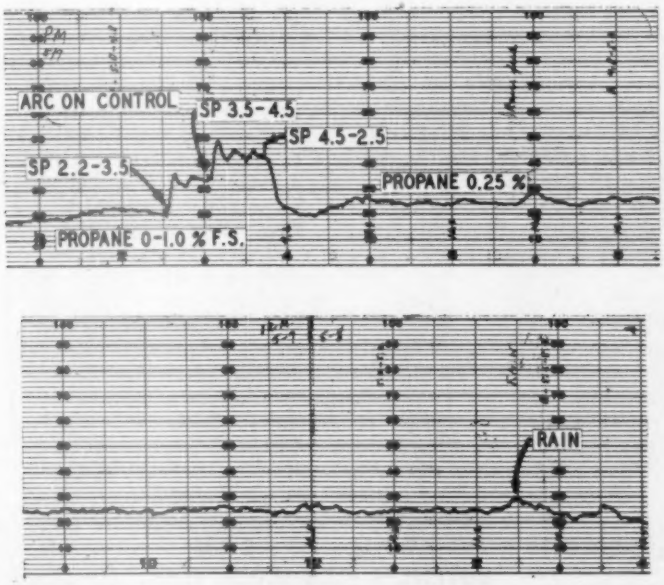


AUTOMATIC chromatographic control of NGL depropanizer. **Fig. 2.**

Control setup . . . The high-speed chromatographic analyzer is suitable for closed-loop control of fractionators and absorbers in those instances where present operation is based on a TRC (temperature-recorder-controller) system with a set point determined from initial-boiling-point or end-point data, or from laboratory analyses.

Temperature control is a form of composition control, even though nonspecific in nature. Used with monitoring analyzers, plant tests, or occasional laboratory analyses, this system is adequate for quality control of column products. However, the limitations of the TRC system allow room for improvement.

Temperature somewhere in the fractionator must be correlated with product specifications. Frequent adjustment of the TRC set point, based on end-product analyses, must be made to compensate for lack of good correlation between temperature and product specifications. Quality-control tests, no matter how simple, are usually an hour or so behind the process. Therefore, a margin of safety must be included in operating procedures to cover the possibility of operating off-specification between tests. Another margin of error must be included to cover the inaccuracy of nonspecific measurements; for example, an initial-boiling-point test is not a quantitative measurement of the light key.



PROPANE (0-1%) in tray 1 vapors when under chromatographic control through set point changes and normal operation. **Fig. 3.**

These margins can be narrowed somewhat by the use of monitoring chromatographs to measure components of interest. Even with a monitoring instrument giving a specific measurement, the operator is still allowed a margin of error because it would be physically impossible to be continually changing the TRC set point to maintain the composition constant. When a TRC set-point change is made, it can only be an approximate setting, and subsequent analyses are required to check the new set point.

The high-speed chromatographic analyzer, in closed-loop control, practically eliminates the need for these safety margins. Some plant tests are eliminated entirely by the specific measurement of the light key in the bottoms product or the heavy key in the overhead product. No correlation with column temperature-pressure combinations is necessary. With high-speed chromatography, as soon as deviation from set point is recognized by the analyzer, no matter what the cause, steps to correct this are started immediately.

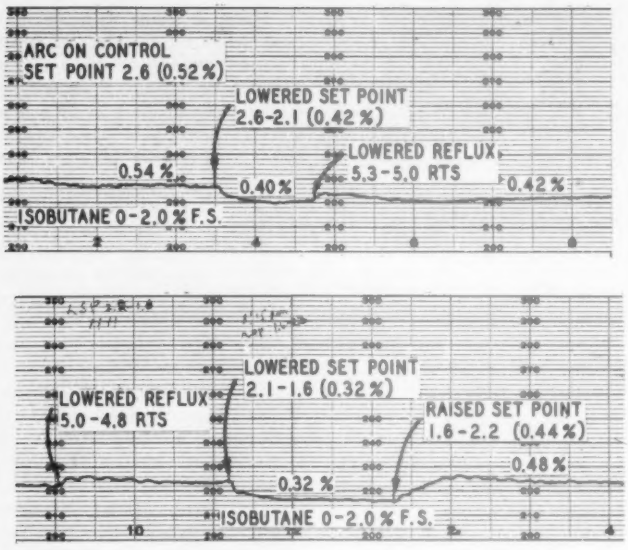
This does not mean that a fractionator or an absorber can operate unattended any more than with TRC control. It means only that fewer plant and laboratory quality-control tests are needed, set-point changes are unnecessary (unless specifications are changed), and that the margins of safety and error described above are eliminated.

Another consideration in favor of analytical control is the ease with which utilities, such as power, steam, and cooling, can be saved. Given excess capacity, frequent practice is to use more reflux (and absorber oil) than necessary, entailing more steam and cooling requirements. While this often assures better-than-specification product and "smoother" operation, it also raises operational costs. With the high-speed chromatographic analyzer handling product specification, operator experimentation can determine what conditions are best to drive a fractionator or absorber just hard enough to meet minimum product specifications.

These factors contribute to the incremental gains possible with a chromatographic analyzer in closed-loop control of fractionators and absorbers.

It is obvious that, in those processes where temperature-composition correlation is almost perfect, where feed rates and composition are quite constant, or where there is nothing to be gained by making product at minimum specification, the additional cost of analytical control is not justified.

Closed-loop control . . . A prototype



ISOBUTANE (0-2%) in overhead vapors when under chromatographic control. Effect of changes of set point and reflux rate. Fig. 4.

of the high-speed chromatographic analyzer was installed for closed-loop control of a depropanizer in a 500,000-gal. per day gasoline plant and a furfural absorber in a butadiene-recovery plant.

In the depropanizer operation, the feed is a composite of raw natural gasoline from several plants in the area. Feed flow rate and composition vary widely. On this fractionator, the period of oscillation of the tenth-tray temperature (the usual control point) is about 8 minutes. That of propane concentration in the first tray vapors is the same, as shown by Fig. 1. Fig. 1 also points up the need for analyses as frequently as possible. In this instance, eight analyses per period provide an approximation of the sine wave, but more frequent analyses would have done so better. Conversely, it would be impossible to follow the period of oscillation with analysis cycles of 3 minutes or more. It appears, then, that a chromatographic analysis cycle of one minute is fast enough for control of this depropanizer.

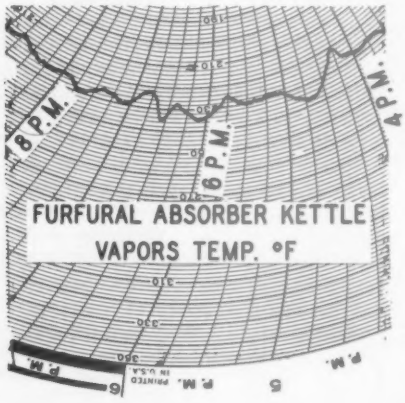
The first control system used on the depropanizer is shown in Fig. 2. The chromatographic analyzer-recorder-controller (ARC) measures propane in the first-tray vapors and manipulates the motor valve on the steam to the reboiler to keep a constant amount of propane in the depropanized natural gasoline. It should be noted that the output of the ARC is connected directly to the motor valve. The analyzer is calibrated in terms of mole per cent propane in the kettle product. This is in contrast to the usual procedure for chromatographic control[3] wherein the output of the ARC is fed to a TRC and FRC in a cascaded system.

The high-speed chromatographic analyzer maintains propane in the bottoms product at 0.25% (±0.05%). Fig. 3 shows that recovery from rather large set-point changes is good. At one point a rainstorm occurred. This normally requires a corrective action by the operator, but it can be seen that the analyzer maintains steady control through this disturbance.

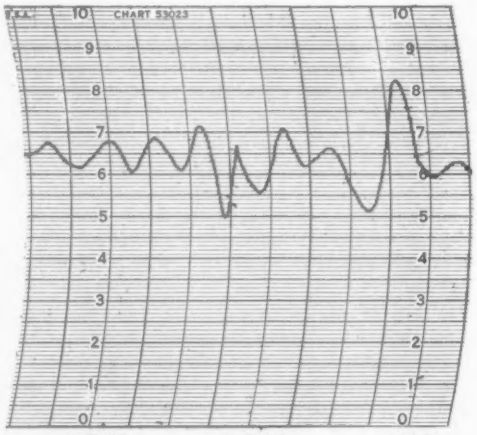
While the system maintaining the light key component in the depropanizer bottoms product controls well, an alternate control system uses the analyzer to maintain a certain amount of butane in the overhead product. It is the same as in Fig. 2 except that the measurement point is at the top of the column. Isobutane was maintained at 0.5% (±0.1%) for the duration of the test run. Set-point changes were made both on the ARC and on the reflux FRC.

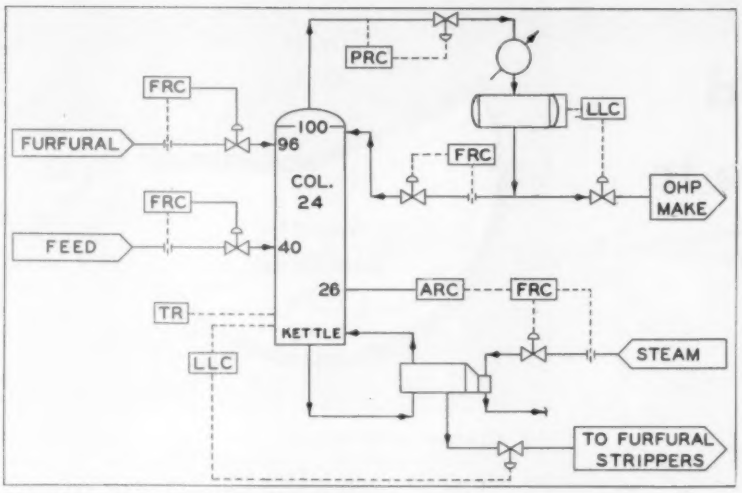
Fig. 4 shows good recovery of the system from set-point changes, but recovery is not as fast and definite as when the measurement is at the bottom of the column. The slight oscillations indicate that a bare minimum of reflux was being used. The elapsed time between making an ARC set-point change and detecting a composition change in the overhead product is about 5 minutes.

In the furfural absorber application the high-speed chromatographic ana-



RECORDS of furfural absorber composition and temperature during rapid column fluctuations. Fig. 5.





FURFURAL ABSORBER CONTROL SYSTEM using high-speed chromatographic analyzer as primary composition sensing device. Fig. 6.

lyzer is used to maintain a desired concentration of the key impurities in the absorber bottoms product. This is accomplished by manipulating the steam to the reboiler to control the concentration of the sum of the components, butene-1 and isobutylene, in the twenty-sixth-tray vapors of this 100-tray absorber. Previous work with other composition analyzers has established a good correlation between twenty-sixth-tray composition and bottoms-product composition.

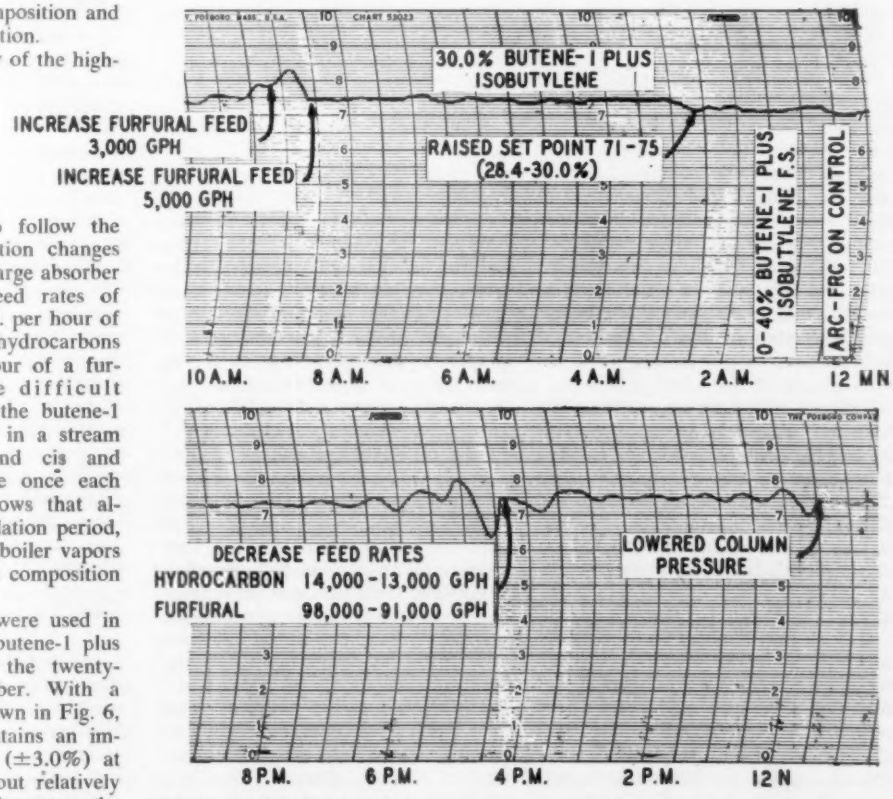
Fig. 5 shows the ability of the high-speed chromatograph to follow the relatively rapid composition changes which can occur in this large absorber while operating with feed rates of approximately 14,000 gal. per hour of butadiene-rich (30%) hydrocarbons and 100,000 gal. per hour of a furfural-water mixture. The difficult analysis of determining the butene-1 plus isobutylene content in a stream containing butadiene and cis and trans-butene-2 was made once each minute. Fig. 5 also shows that although of the same oscillation period, the temperature of the reboiler vapors is not directly related to composition on the control tray.

Two control systems were used in maintaining the desired butene-1 plus isobutylene content on the twenty-sixth-tray of the absorber. With a single cascade system shown in Fig. 6, the chromatograph maintains an impurities level of 30.0% (±3.0%) at the sample tray throughout relatively large disturbances. In this system the chromatographic analyzer-recorder-controller (ARC) resets the set point of the flow-recorder-controller (FRC) controlling the steam to the external reboiler.

Fig. 7 shows the composition control obtained with this system during a period of several large, deliberate disturbances. The period of oscillation is about 30 minutes. The elapsed time between making an ARC set-point change and detecting a composition change on the twenty-sixth tray is approximately 6 minutes. A change in furfural flow produces a change in twenty-sixth-tray composition within 6 to 7 minutes and a change in kettle-vapor temperature within 7 to 8 minutes. Response times for composition changes include 1 minute for chromatographic analysis plus any dead time between composition change and start of the analysis cycle.

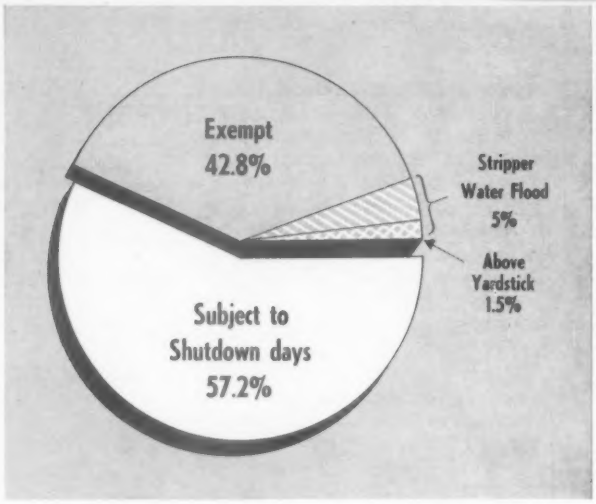
The second control system is identical to the one shown in Fig. 6 except a temperature-recorder-controller (TRC) is inserted between the ARC and the FRC to form a double cascade system. Here, the ARC manipulates the set point of the TRC, which in turn resets the set point of the FRC controlling the steam. The oscillation period of this system is about the same as the first system.

It is difficult to achieve the same product uniformity by using the analyzer simply as a monitor of the key component. The problem would not exist if feed rate and composition were fairly constant, but such is not the case. Continuous attention is required to maintain the key component at either end of the fractionator or in the absorber bottoms at a constant value.



BUTENE-1 PLUS ISOBUTYLENE (0-4%) in twenty-sixth tray vapors of furfural absorber being controlled with high-speed chromatographic analyzer. Fig. 7.

Curtailment could destroy incentive to develop stripper floods in Texas



THE RELATIVE UNIMPORTANCE of stripper water-flood allowable above yardstick average is shown here in graphical form.

• Proration of water-flood production to normal yardstick level would reduce the state's total output by only 1.5%. Some distinction must be made between stripper water floods and pressure-maintenance projects.

BY GEORGE H. EDGERTON
Edgerton & Stearns,
Austin, Tex.

A HEARING has been called by the Texas Railroad Commission, on its own motion, to consider whether pressure maintenance and water floods should be placed on a comparable basis with respect to allowables.

This hearing has been set for June 16, 1960.

The stated purpose relates to incentive. The questions raised with reference to distribution of allowables go much further than a consideration of fluid-injection projects only. They involve the allocation of market demand to all sources of crude petroleum and related products, including gas liquids. The subject of incentive can only be evaluated through consideration of the economic factors involved, though it is ultimately measured by its results.

Pressure maintenance or secondary recovery? Presently, pressure-maintenance production in Texas far exceeds stripper water-flood production. It is evident that the issue presented is: Should greater incentive be given to pressure maintenance as related to water floods? This presents an interesting paradox when considered in the light of the results of present policy.

Unless the industry is accurately informed as to the actual percentage breakdown of allowable distribution in Texas, this issue might serve only to generate useless controversy with no accomplishment other than possibly to cripple water-flooding operations. Beneficial results could be achieved if a modernized production-reporting system were devised and adapted to machine accounting which could provide monthly data as to the amount of production from all sources. Greater attention might be given to allowables in relation to primary-development spacing with intent to reverse the undesirable trend of more wells and smaller total reserves which has occurred since 1952, Table 1.

The Texas Railroad Commission adopted capacity allowables for stripper water floods 10 years ago in the spring of 1950. If these water floods were prorated to the normal yardstick level and subjected to the present low level of producing days, the reduction would amount to only 1.5% of the state's current daily production of crude oil, and a lesser percentage if gas liquids production is included. The total of all stripper water-flood production is approximately 5% of the current state total.

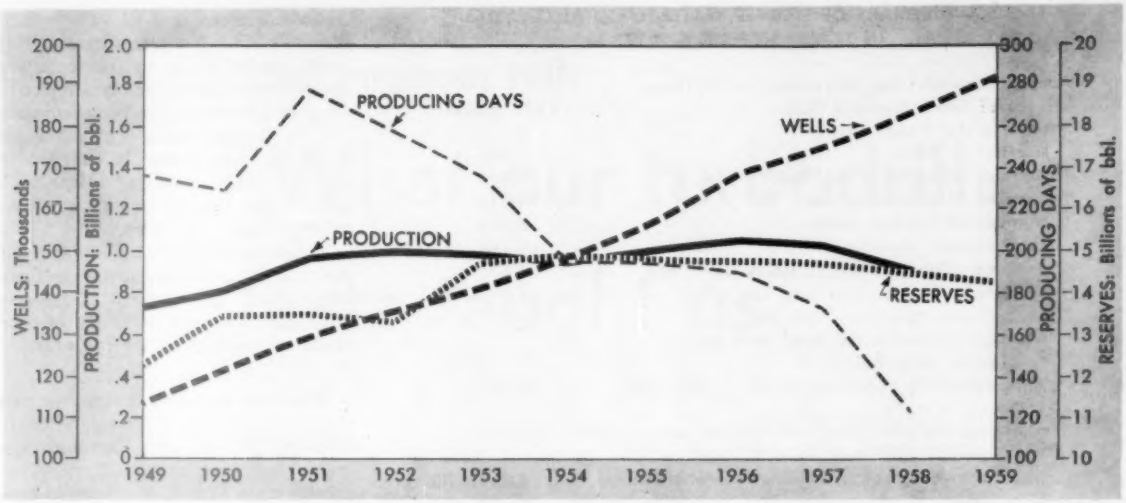
The opponents of capacity allowables for stripper water-floods have published numerous papers reflecting their views with respect to the physical-recovery aspects of stripper water flooding. The curious fact pertaining to this water-flood rate controversy has been that the least emphasis has been given to the actual allowable effect of capacity allowables for stripper water floods.

During the past 5 years or more, news items have appeared in the press making reference to increased restrictions of oil production in Texas. Usually mention is made that the "exempt" portion of this production is increasing, followed by some discussion of water-flood capacity allowables. Because the exempt portion of the state's allowable oil production exceeds 1,000,000 bbl. daily, the impression is obtained that capacity water-flood allowables must be responsible, in large part, for the 9 to 10 producing days allowed per month.

Frequently the term "secondary recovery" is applied, without distinction, to all types of fluid-injection programs, thereby creating the erroneous impression that stripper water-flood production is a major factor in the reduced allowable rate currently in effect.

Some form of secondary recovery will be used by the majority of the oil operators in Texas at one time or another. For this reason it is important that they are not misled into the belief that a significant allowable benefit could be gained for other production at this time by tampering with the stripper water-flood allowable. Most reservoir engineers who have worked primarily in water-flood operations in many areas, insist that water floods must be produced at capacity to obtain the highest recovery of oil.

What is "capacity?" The term "capacity," to a person not familiar with water flooding, implies high oil-production rates as a consequence of most, if not all, stripper water floods. The facts are that capacity for the great majority of water floods is a rate well below the normal prorated allowable. In those floods which do achieve rates above prorated levels, these peak



ONE OF THE most significant factors affecting the number of producing days in Texas is the constant increase in the number of producing wells. Annual production and reserves show little change.

periods represent a relatively short portion of the life of the flood. A typical water flood may have an operating life of 15 to 20 years, with a peak of 6 months to 2 years unrestricted. A water-flood project which covers a large area may appear to sustain a longer peak period which would result from successive production peaks merging as flood development advances. The most explicit evidence of the averaging effect of many factors affecting water-flood producing rates is the fact that in Texas the average calendar-day allowable for a water-flood well is 9.87 bbl.

In the resolution of any issue a misunderstanding of the facts can only do a disservice to the industry. A summary tabulation of stripper water-flood allowables in Texas for September 1959 is presented as Table 2. To place the matter in proper proportion the following should be kept in mind:

1. The total stripper field water-flood allowable in Texas in September 1959 amounted to a little over 5% of the state's allowable.

2. The "capacity effect" expressed in the amount of water-flood allowable above ordinary prorated levels for leases under water flooding amounts to about 1.5% of the state's allowable.

3. Currently the average allowable per well of all stripper water floods in Texas is slightly under 10 bbl. per well per day.

4. Capacity allowables for stripper water floods are not automatic, but are granted by the commission only after the performance history is presented by the applicant.

5. In the next few years water-flood oil production should increase to a limited degree. But most of the state's fields of substantial size will have initiated either pressure maintenance or some form of fluid injection prior to the field's reaching the stripper level, thereby eliminating the capacity allowable.

TABLE 1—SUMMARY OF TEXAS PRODUCTION, RESERVES, NUMBER OF WELLS, AND PRODUCING DAYS, 1949-1959

Year	Production thousand barrels	Number wells	Number producing days	API reserves billion bbls. (at 1st of year)
1949	737,626	115,000	238	12.48
1950	817,842	123,000	230	13.51
1951	991,982	130,000	278	13.58
1952	1,009,792	136,000	259	15.31
1953	1,000,544	142,000	236	14.91
1954	954,434	149,000	194	14.99
1955	1,022,480	158,000	194	14.98
1956	1,078,885	169,000	190	14.93
1957	1,057,997	177,000	171	14.78
1958	909,957	183,000	122	14.55
1959	943,570	191,000	123	14.32

Why so few producing days? The number of producing days in Texas has been reduced from 259 days in 1952 (21.6 days average per month), to 10 days average per month in 1958 and 1959. The year 1952 is selected primarily because the API estimates of oil reserves in Texas in any subsequent year have not exceeded the 15.31-billion-barrel estimate for 1952.

There are a number of factors which have contributed to the reduction of allowable producing days:

1. One of the largest impacts on allowables generally in recent years has resulted from the installation of large unitized pressure-maintenance programs which have prevented the normal declines in productivity experienced in earlier years in the depletion-type or solution-gas-drive fields.

2. In 1952 Texas produced over 1 billion barrels of oil from 136,000 wells averaging 21.6 producing days per month; in 1958 production was 900 million barrels (10% decline from 1952) from 183,000 wells averaging 10 producing days per month (a 35% increase in number of wells and a 50% decline in producing days). At the same time API reserves declined from 15.31 billion barrels in 1952 to 14.55 billion barrels in 1958. By January 1, 1959, the API reserve estimate declined to 14.32 billion barrels. In September 1959 the number of producing wells increased to 191,000. These figures furnish a considerable part of the explanation for the 50% decline in producing days. Obviously the much larger number of wells significantly reduced the per well production since the total annual production has remained static or dropped in the order of 10%. Add to this the fact that this large increase of primary development has coincided with a decline in reserves. These figures deserve some major attention

TABLE 2—SUMMARY OF STRIPPER WATER-FLOOD ALLOWABLES IN TEXAS, SEPTEMBER 1959

Average calendar-day allowable for all Texas as of September 26, 1959	2,795,625 barrels
Stripper water floods only	
Number of fields	250
Number of leases under water flooding	2,004
Number of producing wells	14,640
Number of injection wells	5,324
Total number of wells	19,964
Prorated allowable per schedule day*, bbl.	21,630
Marginal allowable per day, bbl.	8,987
Exempt allowable per day†, bbl.	181,531
Average allowable per total well per calendar day, bbl.	9.87
Total allowable above yardstick per day, bbl.	40,268
Allowable for stimulated water floods per day‡, bbl.	141,015
Stimulated flood allowable as % of state	5.044
Flood allowable above yardstick as % of state	1.440

*This figure reduces to 9/30 of 21,630 on a calendar-day basis. †This figure includes county regular and Panhandle marginal and exempt. ‡Numerous leases listed above appear to be inactive or unsuccessful. At least 25% of the projects appear to be in this category, hence 75% of the prorated and exempt figures was used to calculate the allowable for stimulated water floods. The marginal allowables were considered as nonstimulated.

from all operators.

3. The increase in exempt allowable has sometimes been considered a large factor in the reduction of producing days. In evaluating this effect it should be borne in mind that this increase has occurred primarily in the marginal-well classification where approximately 100,000 bbl. daily have been added in the past 18 months. A recent study reflects that of the 191,000 wells in Texas, 101,000 wells are in the exempt catagory with a total allowable of 1,151,349 bbl. This is an average allowable of 11.4 bbl. per well per day. The exempt allowable is underproduced about 25%, which would yield an actual average daily production of 8.5 bbl. per well per day. If the discovery allowable portion of exempt allowable is excluded, the average per well production for exempt wells would be lowered to about 7.5 bbl. per well per day.

The prorated wells number about 90,000 with a calendar day allowable of about 1,538,000 bbl., or about 17.1 bbl. per day per well. Since the underproduction of the wells subject to shutdown days is less than one-half (10-12%) that of the exempt wells, it is apparent that the actual daily production from wells subject to shutdown days is nearly twice that of the exempt wells on a per well basis.

4. At the present time there are 6,698 oil fields in Texas. Of this total, 80 fields (the giant fields) contain 65% of all the reserves in Texas. While these fields now produce about 40% of the state's production, in the past in periods of higher demand they have furnished a larger part of the market. These giant fields, the majority of which either have pressure maintenance, natural water drive, or will have fluid injection before reaching stripper level, are the fields which are of very significant import in the present period of restriction.

5. Obviously the method of handling allowables in the giant fields for fluid injection programs and the use of MER's (maximum efficient rate of production), are matters of real significance. Pressure-maintenance programs usually are designed to increase oil production of an entire reservoir. On the other hand, water floods in portions of large reservoirs are designed to increase oil production on a small group of wells and to expand the flooding process in such a manner that part of the wells are increasing in production rate while other wells are decreasing in production. This latter method of water flooding sometimes is called incremental flooding. Any policy which would force operators to choose pressure maintenance in lieu of incremental flooding (both operating with the same lease allowable limits) will place more oil on the market.

This is not a matter of preventing or discouraging pressure maintenance. To the contrary, it is a question of allowing a choice between the two methods, when a choice is possible, realizing that the incremental flood will not force offset expansion nearly as rapidly as a policy which would require immediate stimulus of all wells to earn allowable. This has reference to fields which are not in the stripper catagory and therefore would not be subject to capacity allowables for leases or unit.

6. A greater amount of allowable above yardstick levels is assigned to primary fields operating under high MER's than the 1.5% attributable to stripper-field water floods.

7. Gas-liquids production in Texas during 1959, according to figures from The Oil and Gas Journal of January 25, 1960, amounted to 22.6% of total crude oil production for the year.

What this means. It is apparent that there are factors of real significance affecting the allowable distribution in major fields which should be given careful study to minimize both specific allowable problems and allowable impact. At the same time maximum flexibility of operation should be permitted. Also, the basis of allowable assignment for future primary development will influence future production restrictions.

From the pattern of total production since 1952, it appears that Texas has not maintained a share in the national demand increase, indicated as averaging 3.6% for the past 7 years. Texas produced 1,009,792,000 bbl. of oil in 1952 and has since then (1952 through 1958), averaged 1,004,870,000 bbl. per year. The reasons for this static market include imports, increase in gas-liquids production, increased crude-oil production in other states, and the increased use of natural gas in the over-all energy market.

It should be apparent from this brief review that the stripper-field water-flood allowable is a negligible factor in the total allowable picture. If the 1.5% of the allowable for stripper water floods which is above yardstick were removed, it is quite doubtful that this allowable would accrue to other Texas production. On the other hand, the flexibility required for the operation of some of the state's finest secondary-recovery projects would be destroyed.

The policies affecting prorated level production increases both in primary fields and in pressure-maintenance fields are internal factors of major significance affecting the allowable restriction trend. The capacity water-flood production above yardstick levels (1.5%) is a trifle. Erroneous publicity could misdirect some industry efforts to solve the over-supply problem. This wasted effort could be applied to some of the real problems affecting the ability of Texas producers to maintain an effective competitive position necessary for continued success.

Shell engineer tells

"What our turbodrilling tests taught us"

Six salient conclusions

1. Turbodrilling cannot, as yet, compete economically with good rotary practices. Where effective bit weight cannot be used with rotary (crooked hole, directional drilling, small hole size, and large surface hole drilling), turbodrilling should eventually prove competitive.

2. Rock bits have generally performed poorly on the turbodrill. Penetration-rate improvements have not offset the drastic reduction in bit footage (often less than 30% that of rotary). The type of bit wear indicates that the cutting structure, as well as the bearings, will require modification for turbodrilling.

3. A few economical turbodrill diamond-bit runs have been made where conditions were favorable. However, inconsistent turbodrill and bit performances have canceled such savings on subsequent runs. More basic research should be conducted to determine the factors affecting diamond-bit performance. Surprisingly, little is known about the effects of crown shape, waterway design, diamond size, quality, concentration and exposure, and drilling variables on the penetration rate and bit life.

4. Turbodrills, as well as bits, need modification before turbodrilling can be used effectively. The characteristics should be altered to provide optimum drilling conditions at the bit (subject to the findings from bit research). The tool should also be redesigned for field servicing and provided with a better shaft seal.

5. A reliable turbine tachometer has been developed and field-tested satisfactorily below 12,000 ft.

6. Current turbodrill equipment, bits, and techniques have been adequately tested under our drilling and economic conditions. Before further field testing can be recommended, basic research in bit design (both rock bits and diamond bits) is needed, and significant modifications in the turbodrill should be made.

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Article presented at 1960 spring meeting, API Southwestern District, Division of Production, Dallas, under original title, "The Status of Turbodrilling in the U. S."

FIELD TESTING of the turbodrill has been discontinued; the owner of this equipment has "moth-balled" it. Research has been shifted from the turbodrill to developing a suitable cutting tool for it.

Still, the industry recognizes its need for a better drilling method using some downhole power unit. Such a method should ultimately offer the best opportunity for making drastic cuts in drilling costs of our deeper, more difficult, directionally controlled wells. This fact makes it important that we assimilate what lessons result from the turbodrill tests.

The tests described here were part of an extensive effort conducted in the United States. The turbodrills tested were both Russian and French; they had been purchased by an oilfield-equipment manufacturer for the purpose of evaluating turbodrilling in competition with good rotary-drilling methods. Work included use of both diamond bits and rock bits.

Not first attempt. Turbodrilling is certainly not a new drilling method. A United States patent for a downhole hydraulic turbine was issued to C. G. Cross as early as 1873. An improved version of this single-stage tool was also patented in the United States in 1884.

The first multistage turbodrill, the forerunner of current designs, was patented in 1924 in the United States by C. C. Scharpenberg. In the same year, a Russian patent was issued to M. A. Kapelyushnikov on a turbodrill utilizing a single-stage 2,000-r.p.m. turbine that was geared down through a planetary gear train to a shaft speed of only 30 r.p.m. A few years later, this complex design was abandoned by the Russians in favor of the multistage direct-drive turbodrill similar to the Scharpenberg design.

Scharpenberg turbodrills, or modifications of this design, were tested intermittently in the United States until 1950, when this work was abandoned because of bearing difficulties and the

insignificant improvement over rotary performance.

Turbodrilling expanded rapidly in Russia. They reported that since 1955 turbodrilling has increased from 65 to 86% of all drilling for oil and gas. This technique has reportedly increased the average drilling rate from 896.4 to 1,210 m. per rig per month (2,940 to 3,970 ft. per rig-month), and the average penetration rate from 9.31 to 13.1 m. per hour (30.5 to 43 ft. per hour) during this period in Russia.

Undoubtedly these improvements represent considerable progress in drilling technology in Russia. However, could the same type of equipment similarly improve over-all drilling performance in the United States; or was turbodrilling to compete as a special-application tool with current rotary-drilling methods in this country? These questions needed an early answer. Therefore, modern Russian and French turbodrills were purchased for reintroducing the turbodrill method in the United States.

Equipment Performance

In general, the mechanical performance of the turbodrill was quite reliable under selected conditions. However, the need for some design modifications was apparent rather early in the test program.

Several oil-resistant rubber materials were tested to provide thrust and radial bearings that would satisfy the drilling requirements in this country. Initially, some difficulty was experienced with the rubber-metal bond, but this problem was eventually solved. Life of the thrust bearings varied widely, however, depending upon the type of drilling fluid and the load on the bearings. Some field tests showed that the life was over 200 hours under favorable conditions, but only 10 to 40 hours under adverse conditions.

The following factors contributed to premature thrust-bearing failures: (1) Oil having a low aniline point (below 160° F.); (2) mud containing abrasive solids (more than 1% sand); and (3) high thrust-bearing loads when the hydraulic and bit loads could not be adequately balanced (±5,000 lb.). In most tests, however, the thrust bearings performed satisfactorily.

A more serious problem was design of the lower radial bearing, particularly when diamond bits were run. There was a wide variation in the amount of fluid lost around the turbine shaft, depending upon the pressure differential across the lower radial bearing and the clearance. Laboratory tests showed that approximately 25% of the circulating volume was vented at the lower radial bearing when 250-psi. pressure differential was imposed across a new bearing. Partial plugging of a diamond bit, or any wear in the bearing, would drastically increase this loss of fluid above the bit.

Besides hampering bottom-hole cleaning and bit performance, venting of fluid through the bearing contributed to rubber bonding failures. In some cases a high pressure differential caused the rubber to wash out between the housing and turbine shaft.

Several methods of sealing or restricting the flow through this bearing were tested, but with only limited success. An improved lower bearing seal is still needed before high-pressure differentials can be tolerated across the bit. The development of an adequate seal should make the performance of the turbodrill and the bits, particularly diamond bits, more consistent.

Diamond bits. Many diamond-bit designs were field-tested on the turbodrill in holes from 5⅞ to 9 in. in diameter, in competition with rotary rock-bit performances. Efforts were made to modify the tested designs to make them more compatible with the turbodrill.

One of the early attempts to provide a long running bit for the turbodrill was the use of a diamond core head with core crusher submounted directly above it. The idea was to cut a core and then mechanically crush

TABLE 1—ILLUSTRATION FOR USING BREAK-EVEN COST CURVES

ASSUMED CONDITIONS

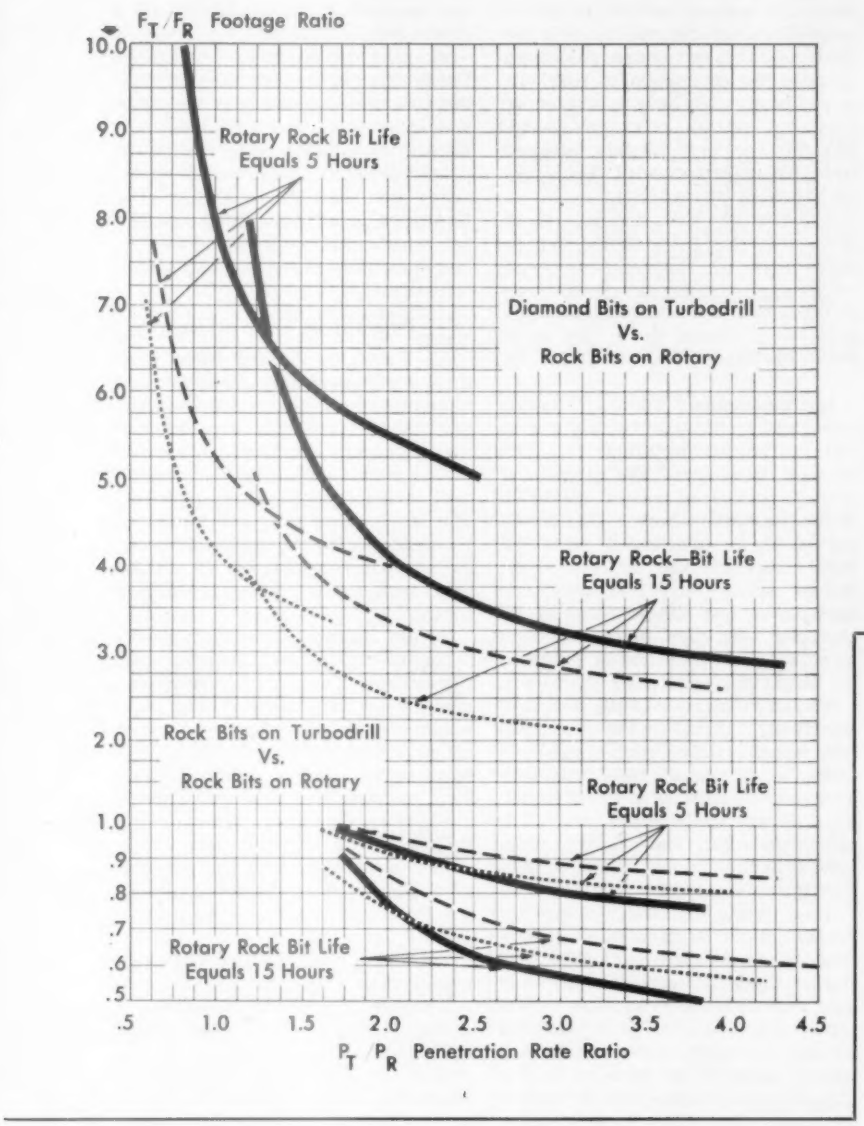
Turbodrill rental:
$75 per day; $25 per hour for first 8 hours; $10 per hour after 8 hours per run.

Net diamond-bit cost—$2,500
Rock-bit cost—$210 (8¾-in.)

Down time:
Rotary—2 hours every 24 rotating hours.
Turbodrill—4 hours every 24 rotating hours.

Turbodrill trip time (compared with rotary)—Same with rock bits but 2 hours longer with diamond bits.

ROTARY ROCK-BIT EXPERIENCE		TURBODRILL PERFORMANCE REQUIRED TO BREAK EVEN
Example A		Example A
Penetration rate, ft./hour	9	For rock bits: 41 ft./bit at 22.5 ft./hour or 38 ft./bit at 36 ft./hour
Bit life, hours	5	
Bit footage, ft.	45	
Trip time, hours	10	For diamond bits: 293 ft./bit at 6.75 ft./hour or 236 ft./bit at 9 ft./hour
Rig cost, per hour	$50	
Example B		Example B
Penetration rate, ft./hour	3	For rock bits: 33 ft./ft. at 7.5 ft./hour or 27 ft./bit at 12 ft./hour
Bit life, hours	15	
Bit footage, ft.	45	
Trip time, hours	10	For diamond bits: 225 ft./bit at 3.75 ft./hour or 150 ft./bit at 6 ft./hour
Rig cost, per hour	$50	
Example C		Example C
Same as Example A except rig cost $75/hour		For rock bits: 38 ft./bit at 22.5 ft./hour or 36 ft./bit at 36 ft./hour
		For diamond bits: 230 ft./bit at 6.75 ft./hour or 185 ft./bit at 9 ft./hour
Example D		Example D
Same as Example B except rig cost—$75/hour		For rock bits: 29 ft./bit at 7.5 ft./hour or 25 ft./bit at 12 ft./hour
		For diamond bits: 167 ft./bit at 3.75 ft./hour or 113 ft./bit at 6 ft./hour
Example E		Example E
Same as example A except shallower depth where trip time—5 hours		For rock bits: 38 ft./bit at 22.5 ft./hour or 34 ft./bit at 36 ft./hour
		For diamond bits: 500 ft./bit at 6.75 ft./hour or 360 ft./bit at 9 ft./hour
Example F		Example F
Same as Example B except shallower depth where trip time—5 hours		For rock bits: 28 ft./bit at 7.5 ft./hour or 22 ft./bit at 12 ft./hour
		For diamond bits: 325 ft./bit at 3.75 ft./hour or 180 ft./bit at 6 ft./hour



ASSUMED CONDITIONS

Turbodrill Rental
$75 per day
$25 per hour for first 8 hours
$10 per hour after 8 hours per run

Net diamond-bit cost—$2,500
Rock-bit costs—$210

Down time
1/12 rotary rotating time
1/6 turbodrill rotating time

Curve: ——————
Rig cost—$50/hr.
Trip time—5 hr.—Rock bits
7 hr.—diamond bits

Curve: — — — — — — —
Rig cost—$50/hr.
Trip time—10 hr.—rock bits
12 hr.—diamond bits

Curve: ----------
Rig cost—$75/hr.
Trip time—10 hr.—rock bits
12 hr.—diamond bits

F_T Footage w/turbodrill
F_R Footage w/rotary
P_T Penetration rate w/turbodrill
P_R Penetration rate w/rotary

BREAK-EVEN COST CURVES for diamond and rock bits on turbodrill versus rock bits on rotary. Fig. 1.

it with cone-type cutters. As expected, penetration rates were high. However, the core crusher proved to be unreliable; it was ineffective when it became jammed with cuttings or when a segment of the core rotated with the assembly.

Some of the early "successes" resulted from runs of a spiral-pad diamond bit that had been designed for turbodrilling in France. This bit was designed to impose a minimum back pressure on the lower radial bearing of the turbodrill. It has very large spiral water courses that radiate from a deep concave center. Although a few bit runs were economical, the performance of this bit was erratic, as it frequently "ringed out" after drilling short footage.

Characteristic type of failure for this bit was very severe wear (or ringing out) on the crown with only very slight wear in the center. Apparently the fluid distribution was inadequate to prevent the buildup of solids around the diamonds, resulting in overheating in this critical area.

Another diamond bit also offered encouragement for turbodrilling. This bit had an individual-waterway pattern with a lower diamond carat weight. It performed very well in medium-hard formations. Wear was excessive when hard formations (chert, quartzite, pyrite, etc.) were drilled, indicating that formation characteristics greatly influenced the bit performance. This design provided better cleaning and cooling of the bit crown, as localized overheating was not experienced. However, two other problems were presented by this design: the pressure differential across the bit was higher, which caused some turbodrill trouble; and the bit occasionally plugged (⅝-in. diameter core hole and ejector port of the bit) when drilling shale.

Several other diamond-bit designs were tested to find a more versatile bit, but each showed definite weaknesses when the formations varied appreciably. Probably the most versatile diamond bit was one featuring a unique bicenter design. This bit measures only 8⅝ in. in diameter, for example, but because of its eccentricity it will drill an 8⅞-in. hole. This represents an important advance in diamond-bit design, since it permits running rock bits alternately without requiring any reaming or reduction in hole size. After turbodrilling with other diamond-bit designs, it was often necessary to ream when rock bits were eventually run; but no difficulty was encountered following runs of the bicenter diamond bit.

Several long runs have been made with this bit on the turbodrill. In fact, nearly 500 ft. was drilled through

abrasive sandstone and limestone with one bit on one of the more recent turbodrill tests. Generally, the wear on this bit has been quite unform, with no indication of localized overheating. However, in very hard formations, gage wear has been excessive.

Normally, the penetration rates with diamond bits on the turbodrill have been about the same as those with rock bits on rotary for drilling sands and carbonates. However, in shale, penetration rates have been lower. This is partly caused by the light bit weights required for drilling shale stringers.

On most tests, bit weights were 5,000 to 15,000 lb. for 8 or 9-in. diamond bits on the turbodrill, while 25,000 to 30,000 lb. could have been used with the same diamond bit on rotary. Limited data showed that the penetration rate improved very little with high turbine speeds (800 - 900 r.p.m. vs. 125 r.p.m. for rotary) when there was such a difference in allowable bit weight. This suggests a possibility that turbine speed might be reduced, if torque could be increased without altering turbine efficiency.

Rock bits. Lower turbine speed should prove far more important for the economic application of current rock-bit designs. In general, rock bits have performed very poorly on the turbodrill because of the very high rotational speeds. The basic problem is one of cutting efficiency. A rock bit may drill two or three times faster on the turbodrill than on rotary, but rotational speeds are probably more than eight times faster. Consequently, bit footage is less as a result of higher rates of bearing and tooth wear per foot of drilled hole. Relation between the two types of wear depends upon the bit size and loading.

Both conventional and modified rock bits have been run in a variety of drilling fluids, including water, low-solids oil - emulsion, low - solids fluid containing extreme-pressure lubricant, salt - water oil - emulsion, and native muds. These tests have clearly shown that turbodrill runs with off-the-shelf rock bits cannot ordinarily compete with good rotary performances, regardless of the fluid properties. In fact, only one successful application was found using currently available bits. Turbodrilling was economical for drilling large - diameter surface holes (in hard formation with unrestricted bit weight), where rotary performance was poor because of drill-pipe "twist-offs." (Gas-storage project near Herscher, Ill., for Natural Gas Storage Co. of Illinois.)

Tests were run on modified rock bits having journal bearings, fluid ports to the bearings, larger - than-standard bearings, altered-tooth patterns, hard facing on the teeth and shirt tails, recessed ball plugs, reduced cone offset, and changes in cone angle. Such modifications are insufficient to broaden the application of rock bits. Sealed-bearing bits have more promise; however, over-all economics would probably be only slightly affected, since rotary performance should also be improved by such bits.

Undoubtedly, extensive research effort will be required to develop a high-speed rock bit. Turbodrilling might compete economically with rotary much sooner if the turbine characteristics were altered to fit the upper limits of rotary rock-bit capabilities.

Instrumentation. Turbodrill testing was greatly enhanced by the use of two instruments: a turbine tachometer and flowmeter. The tachometer made it possible to operate the turbodrill at maximum horsepower, resulting in higher penetration rates. Bit weight was adjusted to control the turbine speed such that maximum horsepower was developed. The tachometer was even more important as an aid in the selection of optimum bit weight during reaming operations.

The characteristics of the turbodrill are greatly affected by the circulation rate (speed varies proportionally—torque as the square, and horsepower as the cube). Thus an accurate knowledge of any variation in circulation rate is desirable. The use of a magnetic flowmeter proved very satisfactory for this purpose.

Two tachometer designs, one hydraulic and the other mechanical, were tested. Both units are mud pulse generators which are driven by the turbine shaft. The hydraulic unit uses a rotary positive-displacement pump to actuate a dart-type valve in the mud stream, whereas the mechanical one utilizes a cam mechanism to control the pulse valve. The pressure pulses are transmitted by the mud stream and are detected by a sensitive pressure-electrical transducer located at the standpipe.

Each pulse, which represents a given number of turbine shaft revolutions, is recorded on a time chart for mathematical conversion to turbine speed. For example, if each pulse represents 200 revolutions of the turbine shaft, 4 pulses per minute (15 seconds between pulses) would indicate a turbine speed of 800 r.p.m.

This method of determining turbine speed has been quite reliable, even to depths below 12,000 ft.; whereas other methods have been attempted in Russia without success, except at very shallow depths. With the development of appropriate equipment, it should be possible to transmit the turbodrill data (bit weight, hole deviation and direction, etc.) in this manner because of the availability of a downhole power source.

Another instrument, a magnetic flowmeter, proved very helpful when the volumetric efficiency of the pump was in question. This equipment performed satisfactorily, even though the properties of the mud varied appreciably from one test to another. The flowmeter is not considered essential for routine turbodrilling; however, it is a substantial contribution to field test data.

Potential of Turbodrilling

In Russia, a limited number of drilling rigs is available and a great number of wells must be drilled each year. A premium price can be paid for increasing the yearly footage drilled by each rig. The Russians report that turbodrilling has improved their drilling performance in two ways: by increasing the penetration rates and by reducing the number of fishing jobs as a result of lower drill-pipe torque.

In our drilling economy, however, a bonus cannot be paid for increasing the drilling rate. Turbodrilling must compete—as any other drilling technique—on a cost-per-foot basis, since rotary techniques meet present drilling requirements in this country. Therefore, identical turbodrill performance could be considered commercially successful in one economy and unsuccessful in another. Increased penetration rates are normally obtained with the turbodrill. However, the over-all drilling rate and economics are influenced by other factors that have proved more important.

Turbodrilling may be considered as a modification of conventional rotary techniques, in which much of the hydraulic horsepower is converted to mechanical horsepower at the bottom of the hole. The hydraulic characteristics of the turbodrill cause very high bit-rotational speeds (approaching 1,000 r.p.m.). Result is higher horsepowers at the bit than with rotary. Since the surface equipment and operational techniques between the two methods are quite similar, the relative economics of rotary and turbodrilling can be readily compared.

Although fewer drill collars (requiring less handling time) are used with the turbodrill, trip time is normally somewhat longer (about the same time with rock bits but 2 hours longer with diamond bits). Additional time is required for checking the turbodrill thrust-bearing wear, laying down one tool, picking up another, and washing or reaming to bottom.

Down time too is significantly greater with the turbodrill. For rotary,

an average of 2 hours per day might be spent for routine maintenance. Normally twice that amount of down time is required for turbodrilling (mainly pump maintenance). Higher rig-operating costs would be expected from higher pump-maintenance costs, but corresponding cost reductions should be obtained with lighter-weight drill pipe and less drill-collar maintenance.

Charting the comparison. Therefore, with rock bits, turbodrilling penetration rates must be high enough to compensate for more down time, less bit footage, and higher rig-operating cost resulting from turbodrill rental. On the other hand, with diamond bits, turbodrilling footage must be long enough to compensate for more down time, more round-trip time, higher net bit cost, and higher rig-operating cost (from turbodrill rental).

The effects of factors influencing turbodrill economics are shown by the break-even cost curves in Fig. 1 and by the illustration in Table 1. These examples clearly show that the economics of turbodrill rock-bit operation are improved by higher rig-operating costs and shallower depths, whereas the economics of turbodrilling with diamond bits are improved by higher rig-operating costs and greater depths.

Since turbodrilling penetration rates with rock bits have seldom exceeded three times that of rotary, the importance of obtaining more than 60% bit footage is apparent from the curves. With bit life less than 3 hours (except in very soft formations) on the turbodrill, a very substantial increase in penetration rate is required to maintain such a footage ratio. Therefore, before turbodrilling with rock bits can compete with good rotary performance, some method must be devised for increasing rock-bit life (to 5 or 6 hours).

Turbodrilling economics with rock bits are best (although still uneconomical with currently available equipment) where: well depth is shallow; hole size is large; rotary performance is poor; rig operating cost is high; formations are medium-hard to hard (nonabrasive); rig hydraulics are adequate; pump down time is not excessive; and the drilling fluid is conducive to long turbine life. More definite criteria can only be established after improvements in bits and equipment make turbodrilling more competitive.

The potential for turbodrilling with diamond bits has been illustrated by several very good economical runs. However, the performance has been too inconsistent to be economical. Based on the better performances, assuming diamond-bit and turbodrill modifications would eliminate the premature bit failures, the following criteria should offer the best applications for turbodrilling.

1. The formation should be conducive to rotary diamond-bit drilling, such as sandstones, limestones, and dolomites (avoid chert, quartzite, pyrite, granite, and soft shale).

2. The mud should not adversely affect turbodrill life (avoid lost-circulation material), abrasive solids (above 1% sand), low aniline point oil (160° F. or below), and high temperature (180° F. or above).

3. Rig hydraulics are adequate and the pumps can be operated at rated loads without excessive down time.

4. Rig-operating cost is high (exceeds $50 per hour).

5. Rotary trip time is long (exceeds 5 hours).

6. Rotary rock bits drill short footages (less than 70 ft.).

7. Rotary penetration rate is low (less than 7 ft. per hour).

8. Rotary rock-bit life is less than 15 hours.

9. Hole size is 9 in. or less.

Penetration rates have been satisfactory in formations that were suitable for diamond-bit drilling. However, the footage was frequently too low for economical operation. The break-even cost curves and illustration—Fig. 1 and Table 1—define the necessary footage and penetration rates for equal turbodrilling and rotary costs. It is apparent from these curves that a moderate increase in penetration rate (in the 0.75 to 1.5 ratio range) would drastically reduce the required diamond-bit footage for break-even costs. Possibly such an improvement could be obtained by better diamond-bit cleaning and higher bit weights, which would require correspondingly higher turbine torques.

Development Needed

In view of the recognized ultimate potential of turbodrilling in deep wells or in directionally controlled wells, the development of suitable downhole equipment should be encouraged because of the trend toward deeper drilling and more directional work. Since currently available turbodrills, bits, and accessory equipment do not provide an adequate combination for commercial operation, development efforts should be redirected toward a more basic approach.

The principal problem that prevented turbodrilling success was poor bit performance. However, the turbodrill characteristics and limitations are believed to have contributed greatly to this problem. An earlier application for this technique might be obtained by designing a downhole tool to fit current bit designs, rather than by designing a radically new bit.

A tool should be designed to approach the upper speed limit of rock-bit endurance (for 5 to 6 hours bit life) without causing a drastic reduction in cutting efficiency (penetration per revolution). The field tests of the turbodrill have shown that present turbine speeds are too high for rock bits and the torque is too low for diamond bits (need to run more bit weight). This suggests that a tool having higher torque and lower speed (perhaps the same horsepower) should perform better with both diamond bits and rock bits than present turbodrills. A few mechanical improvements should also be incorporated into the new tool, such as a better turbine shaft seal, relocation of the thrust bearings for field servicing, etc.

Developing a suitable rock bit for the turbodrill will require time and effort. In addition to the bearing problem, which is currently receiving much of the designer's attention, there is also the problem of modifying the cutting structure to improve the cutting efficiency at high speeds.

Certainly the bearing problem is eliminated in the diamond bit. However, many basic factors influencing diamond-bit performance must be determined before this type of bit can be used economically on the turbodrill. The need for more basic diamond-bit research is apparent from the fact that even the manufacturers are not in agreement on basic design considerations, such as:

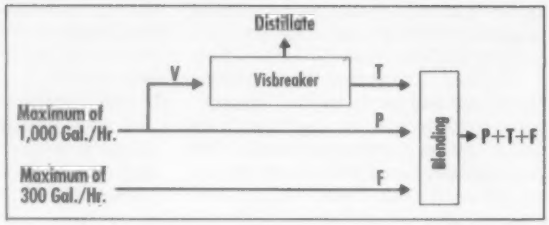
1. What is the best shape for the bit crown? (Flat bottom, convex-concave, sharp crown with deep concave center, rounded crown with shallow concave center, etc.)

2. What determines the best diamond size, quality, exposure, and concentration? (Formation hardness, unit loading, work per stone, linear speed, etc.)

3. What determines the best waterway design? (Pressure drop per inch of bit diameter, circulating volume per inch of bit diameter, bit hydraulic horsepower, waterway proximity to each stone, etc.)

Since the answers to these questions have not been found, the reason for the infinite variety of diamond-bit designs is apparent. As a result of this unlimited variation in design, field testing alone cannot adequately isolate the factors affecting diamond-bit performance. When the design criteria have been established and the optimum drilling conditions have also been determined, a drilling tool can then be designed to provide the right conditions at the bit.

Material	Availability gal./hour	Value cent/gal.	Viscosity blending No.	Gravity blending No.
Pitch	P=1,000—V	*1	37	8
Visbreaker feed	V	*1	...	...
Tar	T=5/6 V	†	11.4	7.2
Flux	F=300	*9	5	24
Fuel oil	P+T+F	6	21 max.	12 min.



*Assume that the fuel-oil blending department is charged 1 cent per gallon for the entire 1,000 gal. per hour of pitch regardless of whether or not it is used, and 9 cents per gallon only for the flux used.

†No tar in excess of that used in blending will be produced. Also assume that the value of the distillate from the visbreaker operation will pay for the visbreaker operating costs other than feed pitch. With these assumptions, no value need be assigned to the tar.

FLOW PLAN and pertinent data for use in solving fuel-oil-blending example. Fig. 5.

Putting linear programing to work

Part I of this series illustrated problem formulation and solution in general terms.

Here is an example which will show linear-programing-solution technique in detail. We will solve it using only ordinary algebra so that each step can be followed easily.

The procedure followed by a computer in solving a problem like this is somewhat different, but it amounts to the same thing.

PART 2 OF 3 PARTS
BY JOHN E. CHENEVEY
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A PROBLEM to be solved by linear programing is illustrated in Fig. 5.

Assume that 1,000 gal. per hour of pitch and up to 300 gal. per hour of flux are available in a refinery for blending to fuel oil. Also assume that a visbreaker of ample capacity is available to be used if needed, and that the charge rate to the visbreaker will be that required to produce just the amount of tar desired for fuel-oil blending; i.e., no excess tar will be produced.

For further simplification, assume that the value of distillate from the visbreaker will pay for operating costs other than the feed pitch and that the visbreaker will be operated at constant severity, i.e., constant yield.

Fig. 5 presents further information in regard to costs, prices, and properties of the various materials. Note that the fuel oil is required to meet a maximum-viscosity and a minimum-gravity specification. Assume that the fuel-oil blending department will be charged 1 cent a gallon for the 1,000 gal. per hour of pitch, whether or not it is used, and 9 cents per gallon for the flux used.

These somewhat unusual assumptions are made in order to demonstrate more clearly some of the detailed features of linear programing. Availabilities of the various materials are also presented in Fig. 5.

Restrictions must be written to insure that all requirements of the problem are met.

The viscosity requirement is written:

$$37P + 11.4T + 5F \leqq 21\ (P+T+F)$$

Likewise the gravity restriction is:

$$8P + 7.2T + 24F \geqq 12\ (P+T+F)$$

Material-balance restrictions are written so that the quantities of materials used will not exceed the amounts available and to account for all of the materials in the problem.

There are three material-balance relationships:

$$P + V \leqq 1{,}000$$
$$T = 5/6\ V$$
$$F \leqq 300$$

A relationship defining the profit in terms of each variable is also required. Profit, designated by Z in this example, can be expressed on an hourly basis: $Z = 6\ (P + T + F) - 9F - 1P - 1V -$ Cost of unused pitch.

It is obvious that there can be some algebraic simplification and condensation of the above expressions. Substituting 5/6 V for T and simplifying:

Viscosity:
$$2P - V - 2F \leqq 0$$
Gravity:
$$P + V - 3F \leqq 0$$
Material balances:
$$P + V \leqq 1{,}000$$
$$F \leqq 300$$

Profit:
$$Z = 5P + 4V - 3F -$$ Cost of unused pitch.

Note that the gravity restriction was multiplied by minus 1 in order to change the direction of the inequality and put the restriction in standard form.

These restrictions assure that all requirements of the problem are met and the profit equation describes the economics of the operation. The restrictions are the "ground rules" of the problem, and these ground rules are never violated during solution of the problem. Accordingly, any requirements can be set up in the restrictions with the assurance that these requirements will always be met. If the requirements cannot physically be attained, the solution will indicate that the operation is not possible.

Next step is to convert inequations to equations. This is done by adding the slack variables A, B, C, and D:

Viscosity:
$$2P - V - 2F + A = 0$$
Gravity:
$$P + V - 3F + B = 0$$
Material balance:
$$P + V + C = 1{,}000$$
Material balance:
$$F + D = 300$$

Slack variable A might be considered viscosity giveaway, since it represents viscosity-barrels below the maximum specification. Likewise B would be gravity giveaway. C represents pitch which is available but not used. The problem was set up so that up to 1,000 gal. per hour of pitch

could be used, but there was no requirement that all of this material had to be used. It only had to be paid for. This means that, if more profit could be made by not using all of the pitch, or if product quality would not permit using all of it, the solution could so indicate. Similarly, D represents available flux which is not used.

The profit equation must now be rewritten to include all of the slack variables with their appropriate profit coefficients. The cost of unused pitch can be expressed explicitly, since slack variable C represents this quantity. The profit equation becomes: $Z = 5P + 4V - 3F + 0A + 0B - 1C + 0D$.

The 0 coefficients are included in this equation to emphasize that all slack variables must have economic-incentive coefficients associated with them. Zero coefficients indicate indifferences to the final values of the variables.

Five equations represent the problem in its complete and final form ready for solution. Four of these are restrictions which set up the requirements on ground rules of the problem. A fifth equation defines the profit for any combination of the variables. There are seven unknowns. Three of these are real variables and the other four are slack variables which were added.

Linear-programing solution procedure will determine optimum values for all seven variables and will also compute a final value for the profit. In this case at least three variables will be zero in the final solution, since with four restrictions there can be no more than four variables with nonzero values. Of course, there is no way of knowing in advance which of the variables will be zero.

At this point it would be usual to turn the problem over to a computer group for solution on a high-speed computer. Details of solution are taken care of automatically by the instructions (called the program) to the computer.

However, this simple example will be solved stepwise in order to (1) show that the linear-programing solution technique is legitimate by the rules of ordinary algebra, and (2) emphasize the important influence the profit equation has on the final solution.

Procedure. Mathematicians have developed a calculation procedure which is efficient for solving large problems, though the method may appear unduly complicated for the present example. For starting the solution it is necessary to rearrange each restriction to isolate a unique variable, that is, a variable which appears nowhere else in the restrictions.

This could be done by a series of rearrangements and substitutions. The first restriction could be rearranged to isolate variable 1. The second restriction could be rearranged to isolate variable 2, and if variable 1 appeared in the second restriction, it would be necessary to eliminate it by substituting its value from the first restriction and so on. It is obvious that such a procedure would become cumbersome for a problem of even moderate size.

An easier way to bring the restrictions into the proper form for starting the solution is to make use of the slack variables. Each slack variable appears one time only in the restrictions. Accordingly, each restriction can be rearranged to isolate the slack variable. This gives the clue to why artificial variables are added to restrictions which are initially in the form of equations.

Applying this technique to the present example:

$A = 0$	$-2P + V + 2F$	(1)
$B = 0$	$-P - V + 3F$	(2)
$C = 1{,}000$	$-P - V$	(3)
$D = 300$	$-F$	(4)

The variables inside the dashed box above are said to be "in the basis." If the variables in the basis have the values indicated and all the other variables are zero, it will be found that these values satisfy all conditions of the problem except maximum profit.

A little thought will indicate that this is true because these values represent the "do-nothing" condition discussed in the graphical example. No raw materials are used and no product is made. Since no product is made there cannot be any viscosity or gravity giveaway, and the slack variables C and D account for all of the materials available.

The profit equation must also be rearranged to a special form. The requirement is that the profit equation must always be in terms of nonbasis variables only. Since C was put into the initial basis, this variable must now be eliminated from the profit equation. Substituting the value of C from Equation 3 above into the profit equation: $Z = 5P + 4V - 3F - 1(1{,}000 - P - V)$

which simplifies to $Z = -1{,}000 + 6P + 5V - 3F$ (5)

The initial trial solution represented by the Equations 1 through 5 is:

$A = 0$	$P = 0$
$B = 0$	$V = 0$
$C = 1{,}000$	$F = 0$
$D = 300$	$Z = 1{,}000$

These values represent a possible mode of operation, but obviously not a very profitable one.

The modified profit Equation 5 contains both positive and negative coefficients. The positive coefficients indicate that more profit could be obtained if the associated variables assumed values other than zero.

For example, the term + 6P in the profit equation shows that there is a potential profit of 6 cents per gallon for every gallon of pitch that can be used. Since the only chance a variable has of taking on nonzero value is for that variable to be in the basis, these potentially profitable variables must be put into the basis. But only one variable may be put in at a time.

The choice of variable to enter the basis is simple. It is the variable with the highest positive coefficient in the modified profit equation (variable P). Any variable with a positive coefficient could be chosen, but it is more efficient in a small problem to choose the largest value.

Since there are four restrictions, only four variables can be in the basis. Therefore, one of the original basis variables must be removed.

The choice of the variable to remove from the basis is more complicated. The method for choosing this variable is the mechanism which prevents negative values for any of the variables.

Selection procedure. The requirement is to find the restriction which will impose the lowest upper limit on the variable entering the basis. The basis variable in this limiting restriction is the variable to leave the basis. The upper limit on the entering variable in a restriction is the value above which the basis variable would be forced to take on a negative value. This will become clearer after going through some actual determinations.

The variable to enter the basis is the one with the highest positive coefficient in Equation 5, which is P. The value of the coefficient is used only for selection of the entering variable. The variable P will enter the basis and we need to determine which of Equations 1 through 4 will impose the lowest limit on P. Only the variables now in the basis and the entering variable need be considered; V and F will remain zero.

It is evident that Equation 4 could not be limiting, since P does not appear in it. In Equation 3 the upper limit on P would be 1,000, since $C = 1{,}000 - P$. At the limit C becomes $1{,}000 - 1{,}000 = 0$. If P increased to 1,001, C would become -1, which is not permissible. In Equation 2 the limit on P is zero, since any positive

value for P would result in a negative value for B. In Equation 1 the limit also appears to be zero.

However, there is a difference for Equations 1 and 2 since the coefficients on P are different. To avoid the nebulous argument whether 0/2 is smaller than 0, it is helpful to replace the zeros in Equations 1 and 2 with some small positive number, say 0.0001. The modified equations for determining limitations then become:

$$A = 0.0001 - 2P \quad (1m)$$
$$B = 0.0001 - P \quad (2m)$$

In this form Equation 2m would limit P at the value 0.0001, while Equation 1m would limit P at 0.0001/2 or 0.00005. It is now apparent that Equation 1 is the limiting equation, so that A is the variable to leave the basis.

In the above case the apparent tie between two limiting equations was really not a tie. However, if a true tie does occur, either equation may be selected as limiting.

The procedure for removing A from the basis and introducing P is:

Rearrange (1) $2P = 0 + V + 2F - A$

$$P = 0 + 1/2\,V + F - 1/2A \quad (1a)$$

Sub (1a) in (2) $B = 0 - (0 + 1/2V + F - 1/2A) - V + 3F$

$$B = 0 - 3/2V + 2F + 1/2A \quad (2a)$$

Sub (1a) in (3) $C = 1{,}000 - (0 + 1/2V + F - 1/2A) - V$

$$C = 1{,}000 - 3/2V - F + 1/2A \quad (3a)$$

Sub (1a) in (4) $D = 300 - F \quad (4a)$

Sub (1a) in (5) $Z = 1{,}000 + 6\,(0 + 1/2V + F - 1/2A) + 5V - 3F$

$$Z = 1{,}000 + 8V + 3F - 3A \quad (5a)$$

These transformations show the first step or iteration in the solution of the problem. Again the basis variables have the values indicated and the non-basis variables are zero, producing the second trial solution:

P = 0	A = 0
B = 0	V = 0
C = 1,000	F = 0
D = 300	Z = − 1,000

This iteration has not produced any profit and the variable P which is potentially profitable appears in the solution at the zero level. This zero value for P is required at this point because the pitch alone cannot meet either the gravity or viscosity specification of the product. However, P is now in the basis and can take on a positive value in some future iteration with resultant production of profit.

The profit Equation 5a, which is now automatically in terms of non-basis variables only, is inspected for the variable with the highest positive coefficient. The highest coefficient is associated with V, which is the new variable to be inserted in the basis. The limiting values of V for the four equations are determined as before.

Equation 4a cannot limit since V does not appear in it. Equation 3a will limit V to 2,000/3, Equation 2a will limit V to zero, and Equation 1a cannot possibly limit V since this term has a positive sign, and any positive value of V can never produce a negative value for P. Accordingly, Equation 2a is limiting and variable B leaves the basis and V enters the basis. The transformations for this second iteration are:

Rearrange (2a) $3/2V = 0 + 2F + 1/2A - B$

$$V = 0 + 4/3F + 1/3A - 2/3B \quad (2b)$$

Sub (2b) in (1a) $P = 0 + 1/2\,(0 + 4/3 + 1/3A - 2/3B) + F - 1/2A$

$$P = 0 + 5/3F - 1/3A - 1/3B \quad (1b)$$

Sub (2b) in (3a) $C = 1{,}000 - 3/2\,(0 + 4/3F + 1/3A - 2/3\,B) - F + 1/2A$

$$C = 1{,}000 - 3F + B \quad (3b)$$

Sub (2b) in (4a) $D = 300 - F \quad (4b)$

Sub (2b) in (5a) $Z = 1{,}000 + 8\,(0 + 4/3F + 1/3A - 2/3B) + 3F - 3A$

$$Z = 1{,}000 + 41/3F - 1/3A - 16/3B \quad (5b)$$

The third trial solution is:

V = 0	F = 0
P = 0	A = 0
C = 1,000	B = 0
D = 300	Z = − 1,000

Again, it may appear as though very little has been accomplished, since there is no improvement in profit. However, two potentially profitable variables, V and P, are in the basis. They are restricted to zero value at this step since no blend of pitch and product from the visbreaker can meet the product gravity specification.

The profit Equation 5b is again inspected. The variable F has the only positive coefficient, hence F must enter the basis. The limiting equation must again be determined. Equation 4b limits F to 300, Equation 3b limits to 1,000/3 and Equations 2b and 1b cannot limit because the F terms have positive signs. Equation 4b is limiting. Accordingly D leaves the basis. The transformations for this third iteration are:

Rearrange (4b) $F = 300 - D \quad (4c)$

Sub (4c) in (1b) $P = 0 + 5/3\,(300 - D) - 1/3A - 1/3B$

$$P = 500 - 1/3A - 1/3B - 5/3D \quad (1c)$$

Sub (4c) in (2b) $V = 0 + 4/3\,(300 - D) + 1/3 - 2/3B$

$$V = 400 + 1/3A - 2/3B - 4/3D \quad (2c)$$

Sub (4c) in (3b) $C = 1{,}000 - 3\,(300 - D) + B$

$$C = 100 + B + 3D \quad (3c)$$

Sub (4c) in (5b) $Z = - 1{,}000 + 41/3\,(300 - D) - 1/3A - 16/3B$

$$Z = 3{,}100 - 41/3D - 1/3A - 16/3B \quad (5c)$$

Inspection of the profit equation reveals that there are no variables having positive coefficients. This indicates that the final answer has been reached. The fourth and final solution is obtained as before. These optimum values are:

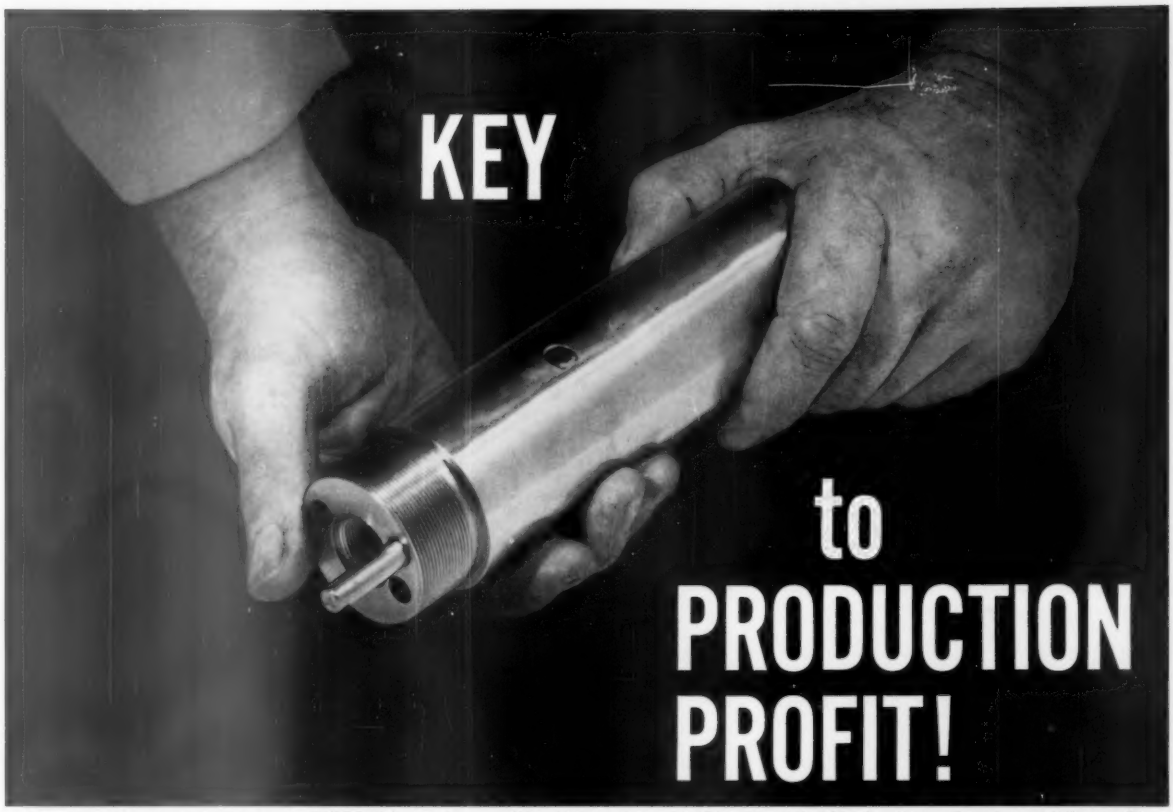
F = 300	A = 0
P = 500	B = 0
V = 400	D = 0
C = 100	Z = 3,100

Interpretation. The value of 300 for F indicates that all of the available flux was used, and this is checked out by the value of zero for D, which represents unused flux. Pitch blended directly to product (P) was 500 gal. per hour and pitch charged to the visbreaker (V) was 400 gal. per hour, leaving 100 gal. per hour of pitch unused (C). Zero values for A and B indicate that the viscosity and gravity of the product were exactly on the limiting values.

Viscosity and gravity requirements are, of course, the reasons that all of the pitch cannot be used with the limited amount of flux available. The maximum profit rate is 3,100 cents per hour including payment for the 100 gal. per hour of pitch which couldn't be used.

The coefficients in the final profit Equation 5c, all of which are negative, are called "shadow prices." These are valuable numbers since they give other characteristics of the optimum solution.

Shadow prices represent the profitability of the last increment of the associated variable which was used. For example, the coefficient of D which represents unused flux is − 41/3. This shows that the last gallon of flux used resulted in 13⅔ cents profit. Or if only 299 gal. per hour of flux had been available instead of 300, the optimum profit would have been 12⅔ cents per hour less.



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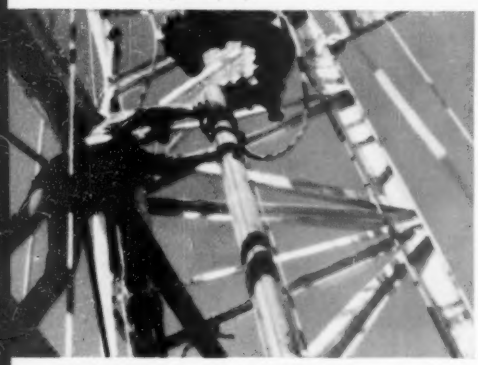

SHELL OIL used over 1,500 feet of 7-inch J&L Extreme Line casing as bottom-hole liner between 10,788 and 12,288 feet in this Louisiana well. Casing gave them increased clearance and positive leak resistance.

THIS NORTH DAKOTA OIL OPERATOR uses J&L Extreme Line casing for high-pressure, deep well completion. Extreme Line casing provides maximum joint strength, high running speeds and resistance to leakage.

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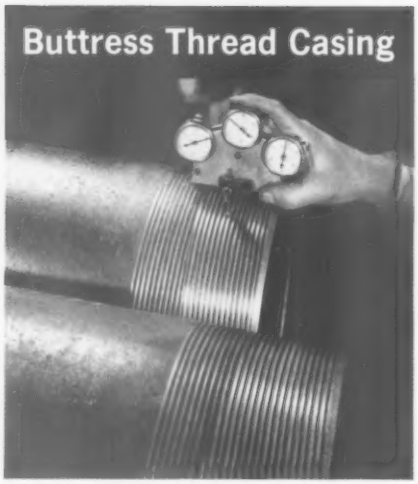
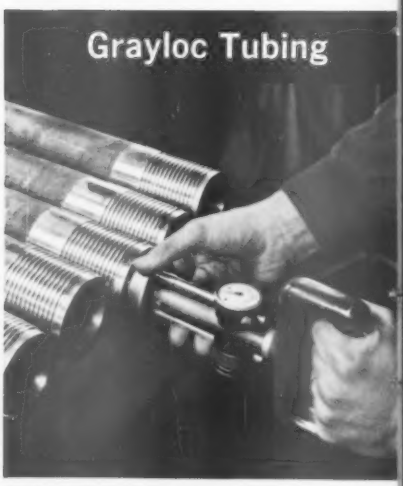


HIGH STRENGTH of J&L Buttress Thread casing is attained by combined effect of completely engaged runout threads and the three-degree flank angle of the thread. J&L's Buttress Thread production and inspection facilities are among the most advanced in the industry.

SUN OIL used 5,813 feet of J&L Buttress Thread casing in this well near Morgan City, La. The high joint strength of Buttress Thread casing in the top sections permits use of longer, heavier casing strings.

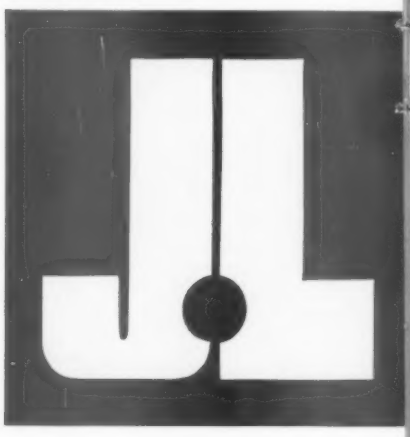
PRESSURES OVER 10,000 P.S.I. at lower depths called for J&L's EHS-150 Buttress Thread casing in this Louisiana well. To meet critical well conditions, operator used 11,650 feet of 9⅝" J&L Buttress Thread casing.

Grayloc Tubing



YOU CAN RE-RUN J&L Grayloc tubing again and again . . . and again. The tubing joint has an independent sealing ring that will hold the highest well pressures yet encountered. Modified Acme-type threads provide easy stabbing, fast make-up, high resistance to damage.

BRIGHT & SCHIFF COMPANY used J&L Grayloc tubing because of limited clearance and high pressures encountered in this dual completion well. Grayloc tubing, except in heavy weights, has smaller joint diameters than conventional external upset tubing.

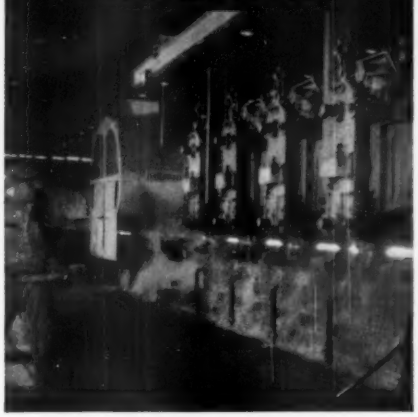


Drill Pipe

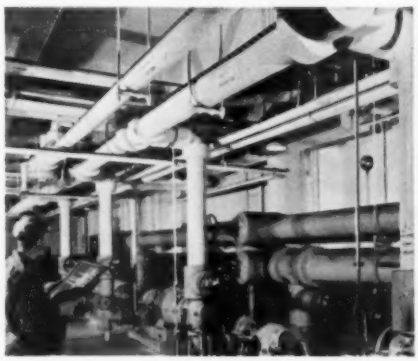
J&L DRILL PIPE is readily available in grades D, E, Blue Ribbon and Blue Ribbon Vanadium. Ends are upset and finished to accommodate Flash Weld and Shrink Type tool joints. Integral joint drill pipe, a distinctive J&L product, is available in Blue Ribbon and Blue Ribbon Vanadium grades.

NEARLY ALL RECORD-DEPTH WELLS have been drilled with J&L seamless drill pipe. Records for longer life and over-all efficiency are established every day with J&L drill pipe. It is made in sizes and grades to meet the requirements of wells to any depth.

Standard Pipe



JAL-CON-WELD standard pipe is produced on two of the most modern continuous weld pipe mills. They incorporate the most advanced equipment to produce high quality standard pipe in sizes ranging from one-half inch through four inch nominal sizes. Each length is thoroughly inspected and hydrostatically tested.



OVER 1800 TONS of J&L's Jal-Con-Weld continuous weld pipe carry steam, water and air through this 34-acre Twinsburg, Ohio, plant. Contractor for the building reports J&L pipe is uniformly round, straight and easy to work. Boilers supply 150,000 pounds of steam per hour through the Jal-Con-Weld pipe.

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EVERY LENGTH of J&L Electricweld line pipe is thoroughly inspected through visual examinations, hydrostatic tests, flattening tests and magnaflux examinations. It is manufactured and tested in strict compliance with appropriate A.P.I. and A.S.T.M. specifications.

SHAMROCK OIL AND GAS CORP. proved superior weldability of J&L Electricweld line pipe on this mountainous operation in New Mexico. Pipe bends readily to contour, is easy to weld and is uniformly round.

THIS CHEROKEE PIPE LINE CO. line in Oklahoma has 22 miles of J&L's 12¾" O.D. Electricweld line pipe. Contractor reports J&L pipe enabled him to avoid delays on the job over hilly terrain.

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The

FOREMAN'S PAGE

How pipe size, roughness, and fittings affect pumping of gas, liquids

IN REFINERIES, pipe size plays an important part in any pumping operation. For a given throughput, the pressure drop due to friction increases rapidly with decreasing pipe diameters. At the same pumping rate, the ΔP through a 3-in. pipe is about 30 times as large as that through a 6-in. pipe.

You can see from this that while the initial cost would be less for the 3-in. pipe, the pumping cost would be considerably higher. Desirable installations are worked out on the basis of economics.

The following table shows the pressure drop when pumping water through pipes of various sizes:

TABLE 1—PRESSURE DROP IN PSIG. PER 100 FT. WHEN PUMPING WATER THROUGH SMOOTH PIPE

Rate g.p.m.	Size of pipe 2-in.	4-in.	6-in.
10	0.12	.....	.....
25	0.67	.....	.....
50	2.44	0.07	.....
100	9.46	0.33	0.05
200	37.50	1.22	0.17
300	.....	2.66	0.37
400	.....	4.73	0.65

Roughness. Another factor that affects fluid flow is the degree of roughness of the internal wall of the pipe. Old, rusty, or pitted pipe would offer more resistance to flow and would therefore increase pressure drop.

Pipe restrictions. Fluid flow is affected not only by the length of pipe but also by the number and type of fittings in the system. The number of valves, the size and type, the number of ells, tees, and orifices; all affect friction loss. The effect of various fittings can be predicted fairly accurately and therefore can be taken into account when designing pipe lines for any particular system.

The effect of these fittings is spoken of as equivalent lengths of pipe. In making pressure-drop calculations, the equivalent length of pipe for each fitting is added to the length of the straight pipe. An idea of the effect of fittings upon the flow of fluid may be gained from Table 2.

This material taken from process-training-program manual, Bayway, N. J., refinery of Esso Standard Oil Co.

TABLE 2—EQUIVALENT LENGTH IN FEET FOR EACH FITTING

Size of pipe	Standard elbow	Standard tee	Gate valve (wide open)
1-in.	1.7	0.8	0.6
2-in.	4.0	2.0	1.5
3-in.	6.7	3.3	2.5
4-in.	9.2	4.5	3.4
6-in.	21.7	10.7	8.1

Pumping

It has been pointed out that a fluid tends to move from a high to a low-pressure area. It has also been pointed out that, in refinery operations, we quite often want the flow to be from a low to a high-pressure area. This, of course, requires the use of pumps or compressors.

In the operation of pumps, pressure drop is of the utmost importance. To operate a centrifugal pump, for example, the suction line can be and often is more important than the discharge line. Although the discharge line may be designed so that the pump is capable of putting the required amount of liquid through it, if the suction line is not large enough or is improperly installed, pumping difficulties will be experienced.

If the pressure drop is such that the liquid starts to vaporize when it reaches the pump, or if suction conditions are not correct, then the pump will not fill properly and will become "gas bound." The pumping rate and discharge will fall off, and the pump will begin to slip and heat up. Slipping can occur with either centrifugal or reciprocating pumps.

In determining the characteristics of the pump to be installed for a particular job, the suction pressure must be taken into consideration. For example, take a pump that has a suction pressure of 0 psig. (pounds per square-inch gage) and a shutoff discharge pressure of 200 psig. This same pump when taking suction from a vessel operating at 100 psig. would have a shutoff discharge pressure of 300 psig.

In the latter case, if the pump were discharging into a system that was good for only 250 psig., this pump could not be used without protecting the system from overpressuring. Installation of a safety valve set for 250 psig. would be one way of providing this protection.

Flow of Gases

Gases, like fluids, move as a fluid. However, gases differ from liquids in that they are compressible while liquids are not. This characteristic is important in the movement of gases. The more pressure that is applied on an enclosed gas the smaller the volume it occupies. Therefore, in moving a gas through a line, the higher the pressure on the system, the more pounds of gas that can be transferred for the same volume rate of flow. This is not true of liquids because they are noncompressible. The effects on refinery operations due to the compressibility of a gas are:

1. Increased pressure means reduced equipment size.
2. Gas, such as air, under pressure can be used to operate pneumatic tools. Low volume times high pressure = high work.
3. Hydrocarbon gases such as propane or butane can be compressed, subsequently cooled until liquefied and sold as liquefied petroleum gases.
4. Certain gases are readily compressed, cooled until they liquefy, and then can be expanded again to gases to produce refrigeration. Example: ammonia.

Flow of Solids

Fluidized solids are finely divided solid materials that behave as a liquid when properly aerated. The catalytic cracking units are good examples of fluidized-solids operations.

Nonaerated, powdered catalyst, which has been allowed to settle in a container has voids of air or gas between the particles as well as in the pores. Its density is about 40-50 lb. per cu. ft.

By mixing more gas with the catalyst the density is decreased. When the density approaches 30-40 lb. per cu. ft. the catalyst becomes "fluidized" or acts like a fluid. In this state, gas films have formed around the particles decreasing the friction between adjacent particles. The fluidized catalyst exerts a pressure at the bottom of a container that is proportional to the height of the catalyst in the container and the density of the gas-catalyst mixture. Since the catalyst in the fluidized state behaves as a fluid, some units which use a solid catalyst can be designed to take advantage of this feature.

WPRA refining quiz on

CATALYTIC REFORMING

Here are portions of a discussion at a regional meeting of Western Petroleum Refiners Association in El Dorado, Ark.

The Panel

W. L. BANKS, Moderator
WPRA Technical Director
Tulsa

P. G. WRIGHT
Mobil Oil Co.
East St. Louis, Ill.

R. W. KERSEY
Derby Refining Co.
Wichita, Kans.

R. A. RATLIFF
Continental Oil Co.
Westlake, La.

R. G. ALEXANDER
International Refineries, Inc.
Wrenshall, Minn.

W. F. JOHNSTON
American Oil Co.
Texas City, Tex.

G. M. ROSE
Tidewater Oil Co.
Delaware City, Del.

O. J. ZANDONA
Ashland Oil & Refining Co.
Ashland, Ky.

G. F. ADAMS
DX Sunray Oil Co.
Tulsa

J. E. HARRELL, JR.
Universal Oil Products Co.
Houston

W. L. VERMILION
Standard Oil Co.
Cleveland

P. S. VERITY
Foster Wheeler Corp.
New York

BANKS: Many reformers are having reactor-shell hot-spot problems due to insulation or shroud failure. What steps have been taken to solve the problem and what degree of success was attained if head shrouds were used? How were they made and how were they installed? If insulation was patched, how was the fresh insulation applied? What type refractory was used?

RATLIFF: We have had some experience with failure of lined reactors in our unit at Lake Charles where we have the conventional UOP radial flow reactors. After about 6 years of operation, we experienced a failure in both the stainless-steel lining and internal insulation and had a hot spot which we were able to keep under control with application of water. We successfully repaired the unit by removing the stainless-steel lining and plugging up the rat hole with a plastic mixture of a standard UOP mix, a mixture of hadite, aluminite, and vermiculite.

After welding the cracks in the stainless-steel liner, we have had about a year's operation on this reactor with no sign of any hot spots. We really don't anticipate any further difficulty with it as long as we are able to keep scale deposits from building up in the annular space. This contributes to a pressure drop which causes a flow-back of the insulation to give you a hot spot.

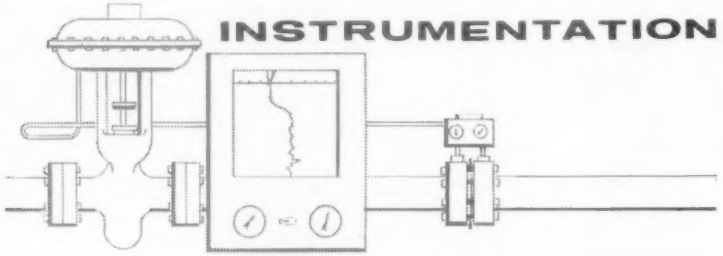
ALEXANDER: We had hot spots initially on the startup of our reformer after less than 8 hours' operation. At that time the reactor had only side shrouds; there were no top or bottom shrouds. Subsequently, we put in top and bottom shrouds and delayed the arrival of the hot spots after startup. We've since removed all the insulation and all the shrouds from the vessels, and we found what we think was our trouble. Behind the side shroud, up on the knuckle of the vessel, was a poor insulating job and there were void spaces back there that you could stick your fist in.

We are currently replacing all the insulation, and we believe that will solve our hot-spot problems. As far as controlling the hot spots during our run, we have just used water on our reactor shells.

VERITY: It is now our company's practice to put shrouds at the top and bottom, as well as the sides, of all these units because we've found it is the only way to avoid developing hot spots fairly early.

KILLEN, JAY, (Sohio Petroleum Co.): Do you prefer to gun the top and bottom heads, or do you have it applied by hand?

VERITY: So far as I know, it is applied by hand, but I am not absolutely certain.



BANKS: What success has been experienced with water analyzers on recycle gas streams? Have they paid for themselves? How accurate are the results? How much maintenance is required?

WRIGHT: We have more experience in these things in pilot units than in commercial units. Although I understand our Beaumont refinery has had one. These things do not read a true water content unless you have

This is Part 1 of the 1959 WPRA El Dorado, Ark., question-and-answer refinery meeting report. Part 2 will deal with catalytic cracking and will appear in the Apr. 7 issue. Part 3, dealing with alkylation, control, instrumentation, and Polymerization, will appear in the issue of Apr. 14. Part 4 (treating, coking, and distillation) will appear Apr. 21.

a calibration curve. Apparently the phosphorus pentoxide cell electrolizes the moisture present to get oxygen. Then the oxygen recombines with the hydrogen in the stream and shows more water, and gives a false reading. Apparently they can be calibrated, however. As far as paying them out, that is pretty much a knotty problem. It becomes a question of whether the knowledge of water in the system is worth money to you. And once you know it, can you do something about it?

FROST, H. C., (Pure Oil Co.): Have yields been increased by reducing moisture? What levels of moisture are being considered?

WRIGHT: I can't comment on the yield portion of it, because there seems to be a great deal of controversy on it. If you talk to the molecular-sieve people, they'll tell you that running that system completely dry is worth a yield advantage to you. I haven't seen any data to prove this. I think the thing is deeper than that, and it ties in with what other contaminants or possible catalyst poisons you have in your feed.

Our own feed runs around 10 p.p.m. by weight, and the water in the recycle gas, then, runs roughly five to seven times that number. Water is determined by a Fischer titration. We feel we can duplicate what we do; you have to be very careful how you take your sample—whether it is a moist day, or if your beakers and glassware are not absolutely dry—and things like that can affect results. Being as careful as possible we at least are certain when our water increases or decreases and the relative amount.

KILLEN: We don't measure the water in our recycle gas nor are we too sure what we are getting in the feed, except we think, too, it is about the 10 to 20-p.p.m. range, but by stopping water injection, which we used to do, we have improved our yields.

JOHNSTON: The original question was concerning the analyzers. We have had some experience with Manufacturing Engineering Equipment Corp. analyzer, and the results have been compared with tests made with P_2O_5 bombs. We have also done some radio-tracer work with the analyzers and found them to be very accurate, always within 10 p.p.m. With proper calibration, we can get closer. One of our big problems is maintenance since the cells become fouled rather rapidly. We always have to maintain a couple of spares—have one going and one coming.

BANKS: Yields are difficult to determine accurately on a commercial unit. Are special techniques such as positive-displacement meters, in use on any reforming units? How do plant yields compare with expected yields?

RATLIFF: We have no trouble at all with ordinary tank gages, still tanks on feed and product lines, and calibrated gas meters, to get within 1.5 wt. % weight balance. If you are looking for something closer than that, I don't know just how you'd get it.

ADAMS: Our general thought on determining yields for analysis of the performance of the unit is to measure the losses, and subtract the losses from the charge to determine the yield. A few per cent error in the measurement, say of the off-gas or the stabilizer-gas, will not appreciably affect the per cent yield of reformate. We find we get better figures this way to analyze trends in unit operation.

WRIGHT: We use orifice meters. We try to compensate for their lack of accuracy by running a great number of yields and then plotting those to see our trends. Any money you can spend to keep your orifice meters up is well spent. You might even caliper the inside of the line at the orifice plate. We've found that there are tolerances that the manufacturer uses in making his pipe, and it can throw your orifice coefficient off a few per cent if you just use the average line inside diameter to determine the orifice coefficient.

ROSE: We find that if we do close our balance within approximately 1% we are lucky. We find that if we don't zero and flush and calibrate all our meters within 48 hours before a test run, our chances of closing a material balance are hurt considerably. We also try to close balances around different envelopes to cancel out any errors in a specific or single meter. I know some people are convinced that the only way to do it is to put in special pipe runs or things like that. I think if you are really interested in accuracy, that may be the answer.

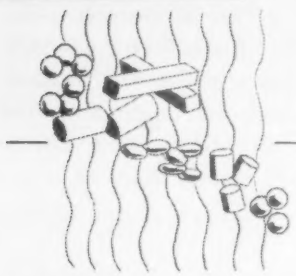
BANKS: Is anyone using refractive index recorders as a means of watching or controlling reformate octane? If so, how reliable and successful are they?

DOWNER, Whit, (Consolidated Electrodynamics Corp.): With reference to the refractometer, one company has done work on that instrument. In general it found the instrument was quite sensitive to research octane number on catalytic reformate, capable of detecting as low as a tenth of a research-octane-number shift, so long as the analysis of the feed, that is boiling range and PONA, remain constant. There has not been a lot of work done on the process refractometer on catalytic reformers. However, I know of several laboratories that are experimenting with laboratory refractometers, attempting to build correlations between refractive index and the research octane number of catalytic reformate. There is a lot more work to be done in this area.

BANKS: Is it necessary to have recycle-gas moisture analyzers close to the recycle-gas line or can the sample line be steam-traced satisfactorily?

PERRY, Maynard, (Consolidated Electrodynamics Corp.): This is with reference to the proper sampling of recycle hydrogen with a moisture analyzer. Quite a number of these are being used very successfully in this application. The average sample-line distance from your point of sampling to the analyzer is 6 ft. We use ⅛-in. stainless steel as the sample line, having in the sample line a 5 to 7-μ filter, and an oil knockout, which has a very small volume. It has been found that the failures that have been encountered in water in hydrogen analysis have not been due necessarily to the analyzer, but to the method of sampling.

Another good technique to use in sampling is not to sample off the bottom of the line, but to sample from the surface of the pipe. We've actually determined the water content on the surface of the pipe inside to be much higher than in the gas flowing in the center of the line.



CATALYST POISONING

BANKS: Has anyone using SBK catalyst had any experience with CO poisoning of the catalyst? Has the catalyst deactivation been temporary or permanent? What chemical reactions are involved in the poisoning of reformer platinum-type catalyst?

VERITY: I think you would expect that CO poisoning would be nonpermanent. Isn't it supposed to be caused by some effect on the crystalline structure of the catalyst? Regeneration would normally restore activity. People often suggest CO poisoning, and then something else is done, and we never seem to get hold of it, actually. But it does exist and is to be avoided.

WRIGHT: When you stated that you thought it had an effect on the intercrystalline structure of the catalyst, but you didn't feel that it was a permanent poison, I just wondered, does that really go together? If you affect the crystalline structure, doesn't that imply that it is a permanent poison?

VERITY: I think you are absolutely right. It does sound like a contradiction in terms. But the facts appear to be that it is not permanent, so I suppose that throws some doubt on whether it really is an intercrystalline affair.

KILLEN: I partially agree with Mr. Verity, although our information differs somewhat, and that is that with some catalysts it is a permanent poison, and some it is a temporary poison. This, I think, is connected to a considerable extent with the way in which the catalyst is manufactured and with its activity.

ZANDONA: We've had a little experience in trying to deactivate a catalyst by using carbon monoxide, and various other catalyst poisons, and we were definitely able to reproduce a loss of activity as a permanent damage to the catalyst by CO injection into a small pilot-unit system. We later analyzed the catalyst itself and noted that the platinum had agglomerated on the surface of the catalyst. It is true that perhaps CO poisoning does not occur in all catalysts, but is related to the manufacturing technique and the operating technique during startup.

ROSE: Probably something that has a lot to do with it as well are the conditions that you have at the time the CO contacts the platinum.

BROOKS, John A., (Standard Oil Co. of Indiana): I want to comment on the statement that Mr. Killen made, that the CO is a permanent poison with some catalyst and not with others. In the Ultraforming process, this CO poisoning is definitely not permanent, and any case of CO poisoning is easily recovered.

KILLEN: We agree with that, having an Ultraformer, and having recovered from CO poisoning many times. I wonder if Mr. Zandona wanted to comment on what catalyst he used to carry out this experiment?

ZANDONA: It was an original catalyst, made by Houdry, and one of the first catalysts they manufactured. It hasn't happened on any catalyst since, using either Houdry or Sinclair-Baker, which are the two catalysts that we have used.

BANKS: After dumping and screening our Ultraformer catalyst it loses its activity until regenerated. Is there a correction for this?

JOHNSTON: The question involves losing activity on Ultraforming catalysts when it is screened. We frequently notice this sort of thing, and regeneration before startup will get you out of trouble.

ALEXANDER: We think we have experienced this deactivation on the Powerforming catalyst. I wonder if that isn't because of a slight hydroscopic tendency of the catalyst to pick up a little bit of water?

JOHNSTON: I'd say no.

BROOKS: There is apparently some association with the conditions used in preparing the catalyst for screening, and not in the screening itself. Activity is recovered immediately after bringing the Ultraformer back on stream by regenerating the reactors. There has been a wide variety of experiences in this regard. A number of people have dumped and screened, and come back on oil without any disability. In any case, I think the variation is a function of how the catalyst was handled before dumping and screening, rather than dumping and screening and handling outside of the reactors.

VERITY: We ought to consider the possibility of picking up CO_2 from the air, which, of course, would go to CO. I understand that this is a very definite possibility.

KILLEN: I think the CO_2 pickup is a definite possibility, but in our regeneration, or coming-up procedure, we would presumably have driven that CO_2 off the catalyst with temperature before we'd had any hydrogen contact. So the CO_2 presumably wouldn't have been adsorbed on the catalyst and had a chance to go to CO.

This is our question, and John Brooks has helped us a lot with this, but we still don't have an answer. The thing that puzzles us is that if we don't dump the catalyst, but do everything else the same, then we don't have the problem. This isn't a real serious problem; it just means we have to go through a quick regeneration of the reactors that were dumped before we have any activity. It does puzzle us, however, and it is an annoyance.

BANKS: In regenerative bed-type units how often is the lead reactor regenerated? Is chloride added to the catalyst here?

ROSE: We regenerate all our reactors in a three-reactor system. We regenerate them, of course, all at once. We do not usually add chloride to the unit during the run. We control our moisture in the charge by fractionation and normally run under 15 p.p.m. We add chloride to the catalyst following a regeneration, in sufficient quantity to bring the specific gravity of the recycle gas back to where it was before we shut down, and then we discontinue it.

BANKS: Is there an optimum H_2S content for hydrogen recycle gas? For the sulfur in the charging stock? Is anyone completely removing all sulfur in the charge and recycle gas?

WRIGHT: The term "optimum" here, to me, implies that there may be a minimum, and I just don't know

about that. As far as what we do, we control sulfur from a corrosion standpoint. We try to keep the sulfur in the charge down to less than 30 p.p.m. This translates, in recycle gas, to about 0.006 to about 0.008% volume. We do not completely remove all the sulfur in the charge and the recycle gas, though.

ROSE: I think the optimum content for the sulfur in the charging stock is as low as you can get it, and we consistently run lower than 0.002 wt. % sulfur. It certainly makes for longer cat life and neater operation.

ALEXANDER: We've had a lot of trouble in analyzing below about 20 p.p.m. on sulfur, and what we've taken to doing is running a blank with isooctane right alongside our analysis, in order to get any reproducability. By keeping sulfur on the charge to the reformer so that it doesn't show any more sulfur by the lamp sulfur test than isooctane does, we can't find any H_2S in the reformer system at all.

WRIGHT: Mobil has a refinery that was built without pretreating equipment. They run between 100 and 150 p.p.m. in the charge, and they don't have yield troubles attributable to sulfur. They are fully protected from the corrosion standpoint. Their biggest problems are heavy metals poisoning. They've had no trouble with sulfur poisoning, as such.

BANKS: When nitrogen is present in a platinum-catalyst Reformer feed in quantities sufficient to poison the catalyst, is it possible to counteract the poisoning effect by adding an acid active agent such as chlorine without causing yield shifts?

ADAMS: We think this would be feasible. But before you do it, you've got to wait to see what is the answer to the next question. Certainly, if you added chlorine to take care of the nitrogen problem, you'd have a considerable quantity of ammonium chloride in the back end of the unit which would have to be handled in some manner.

BANKS: What is the effect of lead on yields, catalyst activity, and catalyst stability in platinum reforming? What has been refineries' experience on the manner in which lead is deposited on the platinum catalyst?

ADAMS: We have kind of an interesting lead story on our reformer at the DX Duncan refinery. It has been operating for about 5 years, and during the past year has had a hydrogen pretreater on it. The feed stock for the unit is high in arsenic, and we used clay treating for a short period, and then acid treating for awhile to remove this arsenic, before putting it in the hydrogen pretreater. However, we have always had pretty high lead content on the spent catalysts. They range from the lowest of 0.2% on up to considerably higher, and at times we've even found metallic lead in the bottom of the reactor where it has been reduced and puddled on us. It has always been a great puzzle where this is coming from.

" . . . hydrogen treating doesn't remove lead, and lead is not as damaging to reforming catalyst as was sometimes thought."

When we put it on the hydrogen pretreater, our next run resulted in our best reformer catalyst life to date of over 100 bbl. per pound. We didn't anticipate finding lead on the platforming catalyst, but in fact, it was the highest we've ever had—1% lead on the first bed. We didn't particularly notice any damaging effect of this lead other than what you would consider normal deactivation of the whole system. We think we may have a clue now, as to where this is coming from. You always suspect tetraethyl as a source of this contamination, but we believe now it may be contamination from some connections into the Doctor treating system. We may have been getting Doctor solution into the platformer feed. Our conclusion is that hydrogen treating doesn't remove lead, and lead is not as damaging to reforming catalyst as was sometimes thought.

ROSE: Do you run temperature profiles on your reactors, and if so, do you notice any flattening in the first reactor?

ADAMS: Although we don't have a profile system on those reactors, we are sure we got flattening on the reactors, because of arsenic. Actually this last run was started a few months before the hydrogen treater was put on and we did have traces of arsenic in the early feed, so I don't believe we could comment on that.

WRIGHT: I have an interesting story on lead, too. We feel that lead behaves the same way as arsenic, and it does affect both activity and selectivity. Our data, though, shows that it does not seem to deposit in a bandwise fashion, as does arsenic. For instance, we have found lead distributed unevenly throughout all three reactors during certain times, and we may find it at higher concentrations at lower bed depths than we will near the top. Our refinery at Paulsboro did have a case of lead poisoning which affected both selectivity and activity. They shut down, regenerated, came back on stream and regained both the selectivity and the activity. But then they lost their activity much more rapidly than normal. Our research people have attributed this to lead.

RYLANDER, C., (Sinclair Refining Co.): Mr. Adams, did you inspect the Unifiner catalyst, to determine the lead level through the bed?

ADAMS: The Unifiner catalyst contained only 0.3% lead when analyzed about the time of the platformer catalyst change.

BANKS: What causes the decline in yields with catalyst age when catalyst poisoning is not indicated?

RATLIFF: Speaking strictly of a permanent loss in activity in the catalyst as it affects yields with catalyst age, we feel that this is due to the agglomeration or growth of the platinum crystals on the catalyst, and to the change in the alumina base of the catalyst. Primarily a decrease in the surface area of the catalyst carrier. Both of these losses are permanent.

BANKS: Is nitrogen gas harmful to platinum catalyst? Nitrogen used for purging may be present during startup. What are the effects of hydrogen pretreatment during startup?

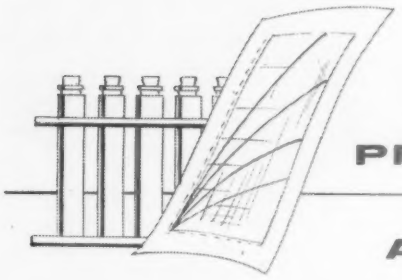
ROSE: I presume here we are talking now about the nitrogen used to pure rather than the nitrogen contained in the charge. We use nitrogen exclusively in our gas during our regenerations, during our startups and we have noted no harmful experience from its use. We think it is a lot better than any inert gas you may manufacture for use during regeneration. We have, in our most recent startups after regenerations, dried with hydrogen.

I might just briefly mention our starting procedure. We purge several times with an inert gas, following the regeneration, dumping the system, and evacuating, and repressuring. Then we fill the system with hydrogen made by the companion reformer, and we take the temperature up slowly to about 450°. We find that we get small

amounts of water, condensed and separated, which are removed from the system. We then dump this hydrogen and repressure with fresh hydrogen. We think that this step, this drying and hydrogen pretreatment step, does some good for us.

BANKS: Has anyone used filters or coalescers in the feed lines to cat reformer desulfurization units to remove scale and moisture? If so, how much benefit is gained in reducing scale deposits on the reactor bed?

KILLEN: Micron filters are not the answer to the problem. We have a 5 micron and it does take out some iron, but a lot comes through. You might use a guard filter with a smaller one following it.



FEED PROPERTIES AND ANALYSIS

BANKS: What are the most profitable cat distillate cuts to reform? Under what conditions should they be hydrogenated? (Sweet crude).

WRIGHT: I think each refinery's economics will dictate this. I suspect that as octane levels increase this catalytic distillate will have to be looked at a little more closely. We feel that the most profitable catalytic portion to reform will be what we call the heavy naphtha, the 250° to 380° cut. We feel that the conditions under which they can be hydrogenated will be dictated by the nitrogen content of that stock. With more nitrogen, of course, more severe hydrogenation conditions.

BANKS: If the initial boiling point of reformer feed is changed from, say, 200° F. to 240° F., there will probably be a change in PONA analysis. Is there a bigger yield change than could be accounted for by the change in PONA?

WRIGHT: I asked this question of our laboratories, and their answer verbatim—is, "Very slight increase, if any." Apparently it is very small, if there is an increase. We're talking about the vicinity of 1%.

JOHNSTON: Over this range we'd ordinarily say there would be no difference in yield, that we wouldn't be able to predict by our PONA. However, if there were some C_6 materials present, these are difficult to aromatize, and if you raise severity, you could very easily get quite a bit of cracking of the C_6's, and in that case, your PONA probably would not indicate the yield changes precisely.

BANKS: What success has been achieved in determining PONA's by chromatograph?

RATLIFF: We have used a chromatograph for routine PONA determinations, but this may be a somewhat special case. This happens to be on the 240° F. dry-point material which we charge on blocked-out operations to our unit for BTX production. In this range, the chromatograph does give very good results, and we have used it as a routine test instrument. If the unit is kept at the proper temperature, the test requires somewhat less than 30 minutes.

VERITY: I just have one comment on PONA analyses in general. In many cases, in a particular project, there may be several different reforming processes under consideration, and we have noticed that the licensors always like to take a sample of the feed stock to develop their own PONA analysis from which to estimate the yields, and in many cases we have received back these PONA analyses, and they are quite different from each other.

I am talking particularly about a case a year ago, where four licensors came up with four completely different PONA analyses. Before you can say whether the chromatograph is giving the right answer, you really have to know what the right answer is. I wonder if there is any industry standardization going on, of this very important analysis in reforming?

ROSE: Well, there is a proposed ASTM mass spectrometer method (Appendix 7, p. 1,101, ASTM Standards, 1958) which was a proposed method, and I believe will be voted on next year. It has limits set for the various hydrocarbon groups and we've been using that at Tidewater for the past 2½ years. We get good checks on our round robin with other refiners and other laboratories.

VERITY: Does it also check against the simpler original methods.

ROSE: No, there is where you run into trouble. If you attempt to compare a FIA and an MS, you are liable to have trouble. Some people have. I think the method used has to be the same if you are going to get any kind of agreement. We are interested in this chromatographic method because it seems to be faster than our MS would be. But until such time as it is proven, I think MS offers the best chance for agreement between different labs.

KILLEN: Do you use the MS for above C-9's or for a 400° F. end-point feed?

ROSE: All we've used it on is about 420° F. end-point material.

KILLEN: You feel that you do get material above C-9's then, apparently, because I think there would be some in there. We've had the same experience as Mr. Verity, and we've done a lot of work on this PONA. We just can't get anything that is reproducible between our labs. It makes such a difference to the evaluation of our operation that it is the most serious problem we have in the reforming field.

ROSE: One further comment on that ASTM method. I haven't seen it lately, but my recollection is that there are certain specified limits for the hydrocarbon groups, but they are not what you might call very narrow. We had good success in comparing with other people. It takes some work and your technicians have to be on the ball.

BANKS: Are there any correlations on feed properties to coke deposition for platinum catalytic reformers?

ROSE: I don't have any definite numbers. We've gotten some good runs in our reformers at Tidewater, using Houdry 3D, and what we watch, in general, are olefins, end point, sulfur, and nitrogen. We pretreat our charge very severely in a Unifiner, and we get complete hydrogenation of the charge. We watch the end point very carefully by observing crude-unit operation. We like to see about a 370°, 90% point. We don't let it get much higher than that. We keep the sulfur out by a pretreat of the charge to less than 0.002 wt. %. That has a lot to do with it. We ride herd on nitrogen and watch our metals. In general, if you have a good pretreater and if you

pretreat your charge severely, you'll get good runs with very low coke laydowns.

CHAMBERLAIN, W. C., (Texas City Refining, Inc.): I was interested in Mr. Rose's comment, and I would ask him one other thing, what kind of hydrogen to hydrocarbon ratio are you talking about, in the reformer with 3D catalyst?

ROSE: We are very fortunate in that we have a rather large unit, and lots of recycle ability. We maintain a 10-to-1 gas-to-oil ratio, about an 8-to-1 mole-to-mole, hydrogen-to-hydrocarbon.

BANKS: Is anyone hydrogen treating a heavy cat naphtha to use as a charge stock for catalytic reforming?

ROSE: We handle heavy cat naphtha in two ways at Delaware City. Our primary method of handling it is to take it out of the splitter at the gas plant, put is through a Petreco caustic-scrub, and then though our Unifiner. Here, of course, we take sulfur out and hydrogenate. We also reduce the octane significantly. We then charge this material directly to our Udex feed prep, where we do some boiling-range tailoring. It goes through the Udex, the aromatic portion goes on with the extract to final blending.

The paraffinic raffinate returns to the reformer with the paraffins from the other reformer charges. From time to time, we have a secondary method of charging, depending upon our stock position and our throughput on our reformer pretreater. This consists of putting heavy cat naphtha in with the intermediate naphtha and charging it through the reformer pretreater, and then directly to the reformer. We have had no fouling problems with cracked stock in the very same unit, under the same conditions, that had produced excessive fouling with coker gasoline.

KILLEN: Has this cat naphtha behaved — product-distributionwise and catalyst-lifewise—just the same as a normal virgin naphtha feed would?

ROSE: As far as we can tell, it hasn't affected cat life. Of course, as you know, we pretreat rather severely. We get a Δ T boost from this heavy cat naphtha which helps us do a pretty fair job on it. We can detect no change in our product distribution. We have an unusual case, in that we take the effluent from our two reformers and put them into a Udex unit and recycle all of the paraffins.

FROST: I'm quite interested in your comment. Do you have any information on the boiling range of this heavy naphtha before and after hydrogenation?

ROSE: A check of several months of operation reveals no consistent or very large change in end point. We do note a gravity increase of about 2° API.

OTTENWELLER, Jerome H., (Cities Service Refining Corp.): Do you have any idea what the PONA would actually be on this material—after the Udex unit—if it were run by itself?

ROSE: We ran a PONA sometime ago on the hydrogenated material. It was 34% paraffins, 24% naphthlenes, and 42% aromatics. From this I would predict 60% paraffins, 36% naphthlenes and 4% aromatics in the Udex raffinate.

BANKS: What is the effect of nitrogen compounds and what level of combined nitrogen in the feed can be tolerated?

WRIGHT: Nitrogen generally inhibits the acid function of the catalyst and tends to deactivate the catalyst. In other words, it causes the higher temperature for the same octane number. The effect is generally felt to be reversible and by removing the nitrogen from the feed, you regain your activity level. We feel there is no effect on yields at low nitrogen levels, but we feel that a massive dose of nitrogen can cause yield shifts. Generally, to prevent nitrogen poisoning, I think we go along with the industry-wide number, and that's about 1 p.p.m. I think you can pretty much get away with 1 p.p.m. without noticing it on your reformer.

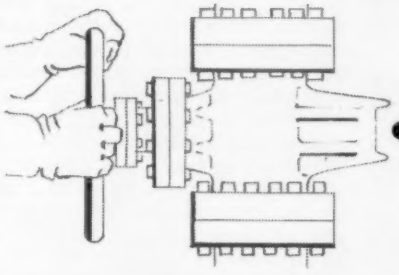
ROSE: Houdry did work sometime ago on the quantitative effect of total nitrogen, and it was found that about 1 p.p.m. of total nitrogen was equivalent to two octane numbers. As a rule, at Delaware City, we run less than 1 p.p.m. of total nitrogen in our total charge. We try to keep it under 1 p.p.m. We think you pay a penalty for nitrogen no matter how little you have, both in reduced octane and in fouling problems as well. The nitrogen, of course, is converted to ammonia, and it will react with chloride in particular to give you fouling.

JOHNSTON: In Ultraformers, of course, we do try to keep the nitrogen low, however we don't have nearly as severe a problem, since we do have a regenerative process. We can run higher than 1 p.p.m. very easily.

WRIGHT: We have frequently run in the vicinity of 1 p.p.m., plus or minus a tenth. That has cost us no noticeable octane number increase. When we get up to 1.5-2.0, it costs us more temperature.

KILLEN: Our experience bears out what Mr. Rose said. We can run our Platformer with 1 p.p.m. nitrogen and we are used to running at that level. But if we are down to about 0.3-0.4 p.p.m. and then go up to 1, we notice a definite increase in temperature requirement. The lower we can get the nitrogen the less temperature it takes.

WRIGHT: Nitrogen is present primarily when we reform coker gasoline. We can see that when we cut it in and cut it out, and we still don't see the effect of it unless we get over 1 p.p.m. of nitrogen.



OPERATION

BANKS: What is the effect of reforming severity on partial pressure of hydrogen and recycle gas? What effect does this change in partial pressure of hydrogen have on run length, catalyst life, product distribution, etc?

JOHNSTON: Increasing the reforming severity, of course, also increase the cracking reaction, which will produce gas and lower the hydrogen content of the recycle gas. This has a very little effect on our regenerative reformers.

VERITY: It is pretty hard to isolate the effect of partial pressure because as soon as you increase reforming severity, which you have to do by changing something, the partial pressure of the hydrogen gets lost in the

effects of the other things you have had to change. The specific effect of partial pressure is very hard to pick out.

WRIGHT: I am not sure I completely agree with that statement. Before I start, I would like to preface my statement by saying our experience is primarily with Sinclair-Baker catalyst, at a high pressure, or a 500-psi. unit. In general, we feel that at leaded research octane numbers above 100, hydrogen-to-hydrocarbon ratios of below 8 to 1 will decrease cycle length. We can't really comment on the life of this catalyst. It looks pretty good to us. As far as product distribution is concerned, that's a little bit difficult, but we know that below 6 to 1 you lay down more coke, so it must affect the product distribution somewhat. How much is still a guess.

ZANDONA: We have operated our reforming unit with recycle ratios of about 4-to-1 hydrogen-to-feed ratio. We've been able, with a lower recycle ratio, to obtain an increased capacity for our units. We haven't been able to note any real effects on product distribution. We certainly haven't lost any yield, and the life of the catalyst now is up about 280 bbl. per lb., so we haven't seen any real loss in catalyst life.

ALEXANDER: I am curious about the effect of partial pressure versus recycle gas rate. Part of the purpose of recycle gas, as I understand, is to give you more hydrogen partial pressure and reduce your coke laydown. Can you achieve the same effect if you hold the partial pressure constant by reducing the recycle gas rate and increasing the pressure on the unit? Do you have the same effects on run life and product distribution?

WRIGHT: Mr. Zandona: What is the cycle time on this 4-to-1 recycle ratio?

ZANDONA: We have regenerated on about a year's cycle. We have regenerated more often on occasions since the regeneration was accomplished not primarily for reestablishing any activity on the catalyst but for convenience of either inspecting the unit or choosing a time for regeneration which would be convenient. We operate at two severities, normally at 93 and 99 leaded.

KILGORE, C. H., (Bay Petroleum Corp.): Mr. Zandona, have you done that on both Houdry and Sinclair-Baker catalyst?

"We have in one case regenerated catalyst three times before finally changing the catalyst."

ZANDONA: No. We have low recycle ratio on one unit only. We were forced into the operation because we needed additional throughput and by reducing the recycle gas ratio we were able to increase the capacity of the plant materially. We have the lower recycle ratios on the Sinclair-Baker unit at Catlettsburg, we have reduced the recycle ratios at our other plants, also, but not as low as the one at Catlettsburg.

OTTENWELLER, J. H., (Cities Service Refining Corp.): What is the PONA analysis of the feed for such an operation?

ZANDONA: PONA analysis runs between 45 and 90% naphthene.

BANKS: In long reforming runs is there significant change in yield during the run? What coke levels have been experienced at the end of a run? Has regeneration completely restored catalyst activity level and have subsequent runs been of equal length and have yields been the same as in the previous runs? If so, how many times has the catalyst been regenerated? Also, on what basis is the decision made to regenerate rather than to return the catalyst for reclamation?

RATLIFF: In commenting on the first section, there is some loss or change in yield structure, as catalyst ages, due to the loss of dehydrogenation and dehydrocyclization activity; and as you are forced to go to more cracking to achieve an octane level, you do change your yield structure considerably. This is even more noted on the unit where we use blocked-out operation, the unit operating about two-thirds of the time on BTX operation. We also experienced a marked increase in ring opening or cracking of the naphthene rings, rather than the aromatization as the catalyst ages and this, of course, causes a marked loss of efficiency.

What coke levels have been experienced at the end of a run? On several runs, before we started to regenerate catalyst (we have a four-reactor system) we found that the coke on the catalyst in the first three reactors was about 1%, 3%, 5%, and in the final reactor, which has about twice as much catalyst in it as the other three, the coke level would run from 6-8%.

Has regeneration completely restored catalyst efficiency level and have subsequent runs been of equal length? No. In no case, since we have regenerated, have we completely achieved the original efficiency of the catalyst, nor has the subsequent run length been as long as the one preceding it. In other words, we feel that there is some permanent deactivation of the catalyst taking place throughout the life of the catalyst, especially in the regeneration step.

We have in one case regenerated catalyst three times before finally changing the catalyst.

ROSE: We've operated our two reformers for over 2½ years now, within our ability to get accuracy on our test runs, we can see little yield loss, but we do see a loss of stability in succeeding runs. What I mean by that is the runs will be of shorter duration. On our Train A, the first run extended to 84 bbl. per lb. When we regenerated that catalyst, we calculated coke at 4.4%.

On the second run in Train A, we ran 69 bbl. per lb., and that run was terminated, simply because it was convenient for us to terminate it then. At the end of that run we found 3% coke on the catalyst. On Train B, the first run extended for 94.6 bbl. per lb. We found 3.1% carbon on the catalyst after regeneration. We are currently regenerating that train now. (We found 2.4% coke). Following any of our regenerations we could see no deterioration of activity, and as I said we did see a loss of stability.

As long as the need for regeneration at Delaware City doesn't affect our ability to run the available charge stock and we don't really suffer yield losses, we will probably retain our catalyst. The way things look now, it is going to go right on.

WRIGHT: We feel that no yield shifts occur during long runs, where no poisoning is indicated. In Mobil units, we have had coke levels of 8 to 18%. At East St. Louis, we've had around 9 and 10%. We feel that regeneration does restore activity, but moisture present in regeneration gases or incomplete coke burning can prevent complete recovery. There are so many factors involved in our runs, and we are always increasing severity. So I can't really comment on whether our run lengths have changed.

"We practice blocked-out operation for octane on one of our units, producing one stock for regular blending and one for premium blending . . ."

KERSEY: We regenerate by shutting down our unit and it is normally done on the basis of what our Ultraformer performance number is, provided our feed and finished stock situation will allow it. But, through subsequent regeneration we definitely have found that our Ultraformer performance number has been higher than when the catalyst was new. It has at times been as high as 150 compared to UPN of 100 for new catalyst.

However, this activity doesn't hold up very long, as it drops off fairly rapidly. It has been very hard to evaluate length of runs because our operating pattern has changed quite a bit, and it is hard to make a comparison between runs.

KILLEN: If we have an activity of 150 we're concerned that it is too high, because you can certainly have a psuedoactivity that is hurting product distribution. I would think you would be glad when it dropped down to a more normal range.

KERSEY: This has never happened on other Ultraformers and I've never heard of any troubles resulting from high UPN's.

OTTENWELLER: Mr. Wright, do you prefer to run at high temperature inlets, or low temperature inlets to your reformers, as a general rule?

WRIGHT: We run the same inlet temperature at each reactor.

OTTENWELLER: How high do you normally think it is advisable to go?

WRIGHT: Our limitation is 980° F. Above that you stand a good chance of getting into naphthene cracking. There's no yield loss at 980° F.

JOHNSTON: Mr. Killen just commented that it might be good to have lower activity, and not have high activity. Our experience has been just the reverse. In other words, the higher the activity the better the yield. We run at high activity and regenerate every 15 hours.

KILLEN: I don't know how to answer this. I think maybe it depends on the basis for the 100 activity or performance number. If you have water left in the reactor from regeneration as you normally do, and a fair amount of chloride in the feed, you can, of course get high hydrocracking rates. This is common experience. I believe that in your plant, too, you'll see this immediately after you bring a reactor back on stream. We don't have any numbers to back up factually that 150 isn't better than 100, so this is just a feeling.

We have had coke levels of 2, 5, and 14% on three reactors. They've been even higher in individual cases.

ROSE: The carbon burnoff figures I quoted for our regeneration are of course, average. We normally find a step up in carbon through the three reactors. Unfortunately, we have only sampled the individual reactors once, and to the best of my recollection, they ran up to 8% and 12%. You are bound to find more carbon in the third reactor.

RATLIFF: Do I understand that in some of these units that we are operating with no permanent deactivation of the catalyst at all, that we can expect an indefinite life from the catalyst?

JOHNSTON: We don't expect it to last forever, but we can make a good shot at it. We've had catalyst in the bed over 4 years old, and have been running considerably above 200 reactivations. We have removed catalyst for reworking, but we are in a very critical situation in the manufacture of unleaded gasoline, and can't afford to have a situation where we even might have deactivation. We set up a reworking schedule, based on a highly conservative catalyst life. We keep pushing that forward and forward.

ROSE: The answer to long runs is proper pretreating. With proper pretreating to get the sulfur levels down, careful regeneration, and no mishaps, there is no reason why you can't get long, long, long lives out of your catalyst. I think sulfur is probably the answer to it all. You get the sulfur out and you'll get along fine.

O'NEILL, J. A. (Ingram Oil and Refining Co.): What catalyst life, specifically are you speaking of? Do you mean in excess of 100 bbl. per lb?

ROSE: I don't have the exact numbers as of this date, but on one train we're up about 180 bbl. per lb. in 2½ years, and on the other about 160. We've seen no loss in activity after the second regeneration on our Train A. We thought, if anything, the catalyst looked even better, and the temperature required for a given octane was even lower than on our initial run. We use a great deal of care in regeneration, and as I say, we severely pretreat. And barring anything catastrophic, I don't see why we can't go on.

O'NEILL: Mr. Killen, how do you sample your reactors to get coke numbers?

KILLEN: These numbers that I gave were back in the days before we were regenerating the Platformer, and we took as best we could composite samples by taking a little bit from every 5 barrels that was dumped out of each reactor.

ROSE: We thief the reactor. Take the top head off and drive a long thief down through the catalyst bed several times, try to get a different angle of attack each time, taking samples at various levels through the bed. I think, if done carefully, you can get a very representative sample at any level of any bed you want.

BANKS: How prevalent is blocked-out reformer operation?

ADAMS: I don't know whether this refers to blocked-out reformer operation on charged stocks or on octanes. We practice blocked-out operation for octane on one of our units, producing one stock for regular blending and one for premium blending, and we do this as a result of computer gasoline-blending programs with which we are unable to argue.

WRIGHT: We practice blocked-out operation on the reformer octane number, at times. Chances are, that if you are doing it, a linear program is telling you to do it. This is the reason we do it. I tried to pick a few things out of our program which, in the past, have thrown us into blocked operation. One is whether or not we pretreat and reform our coker gasoline. Now, pretreating coker gasoline removes a low octane component from our regular gasoline blend. The linear program compensates for this loss by lowering severity and putting reformate to regular.

At one time we attempted to put a value on our catalyst cost, taking penalties at higher severities. That

was throwing us into blocked operation. We have at last realized that we don't have good costs, and we have taken them out of the program. This has smoothed out our operation and tended to increase the severity on the reformer.

ADAMS: The chief reason the computer tells us to do this is to meet an F-2 specification on premium. We are either forced to blend alkylate or high-octane reformate to meet this spec, and a linear program indicates that the blocked-out reformer operation is the most economical way to do it.

ZANDONA: We use blocked-out operations in all of our plants where we have made an economic evaluation of plant operation through computer analysis. We have spot checked the computer calculation with case studies. We feel very strongly that results are accurate. We operate with two severities, again, depending upon the blending program. Each component goes into specific blends. We have one refinery where we have a blocked-out operation on BTX and motor gasoline.

RATLIFF: We are currently practicing using blocked-out operation on a reformer at Lake Charles. One operation is for BTX production; the other is for motor fuel. A new unit which is going in at present and will be starting up soon will be on full-time operation for octane level.

KERSEY: We have practiced blocked-out operations in the past, primarily because the higher octane reformate has less sensitivity than a cat cracked gasoline, and it helped us in meeting a motor octane-number requirement for premium gasoline. Since bringing our alkylation unit on stream, our gasoline-blending economics have indicated to operate the reformer at as low a severity as possible, in our case, 81 clear. It might be of interest, though, that we've made a study that indicates if we go up one octane number higher on regular, we should go back to blocked-out operation, again, going to high-octane severity reformate for premium, and low octane for the regular-grade gasoline.

O'NEILL: Among those who are running a blockout octane operation, does anyone try to segregate crude oils according to the PONA analysis on the naphtha for this blocked-out operation, and if so, do you feel that it is worth while? We're running a blocked-out operation for octanes, and it has been suggested to us that it would be profitable to segregate the crude oil so that we should run for regular gasoline when we are running the crudes with the poorest naphthene and aromatic contents.

ZANDONA: We've given that serious consideration and have done it on occasion, but it is not very often that we find it is convenient to be able to block out our crudes and segregate our stocks.

KILLEN: I would like to ask the panel another question; on these blocked-out operations for two severities, have any of you operated at different pressures for the two severities, and if not, why not?

ALEXANDER: We've operated at two pressures for two severities. Maybe we bent backwards, but for the higher octane run, which was a 98 ON, we operated at 400 psi., and for 95 octane, these are both clear, we dropped back to 300 psi. We were worried about deactivation rate at the higher octane levels, so we went up on pressure and probably suffered additional yield loss.

OTTENWELLER: If these people had reformate splitters, would their programing indicate that they should operate at two severities? Do reformate splitters have any effect on those calculations?

ADAMS: We have a reformate splitter, but we haven't used it as such, and it wasn't considered in the calculations.

WRIGHT: We don't have a reformate splitter, but the calculations I've seen said that it wouldn't have affected our economics, one way or the other.

VERITY: About how long are the blocks that you normally take—a week, or a few days? What is the shortest block you feel would be economic on an average size unit?

WRIGHT: Our own facilities limit that, such as how much rundown time we have, and just what we want to do in the plant. I don't think there is a short answer for the question. We've been in all different lengths of blocks.

ADAMS: We are normally about two weeks on our high octane, which is the shortest run.

ALEXANDER: On these blocked-out operations, do you change your feed rate to take advantage of the lower space velocity requirements for higher octane and when you drop back in octane, shove the feed rate up?

WRIGHT: No.

ADAMS: We sometimes have, depending in part on catalyst activity and charge stock inventories. Of course, if you are making jet fuel, this often will cause your reformer to be run at other than normal capacities, and this can influence your thinking on throughput rates considerably.

BANKS: What are the advantages of bypassing light straightrun gasoline around a reformer when shooting for a constant refinery-pool octane? Assume sufficient reforming capacity to run your total full-boiling-range straightrun gasoline.

WRIGHT: I have seen some workups that indicate that reforming total full-range gasoline may be advantageous, especially at higher severities. Apparently what happens is that the PONA analysis on the lighter fractions run approximately constant, and the effect is that as you drop the light straightrun portion into your reformer charge, you raise the octane number on the light straightrun material. This allows you to operate at a slightly lower severity on your reformer to make the same pool octane around that system with perhaps more yield, or if you operate at the same severity, the higher pool octane number. This could be more a function of your ability to fractionate between the two cuts than anything else.

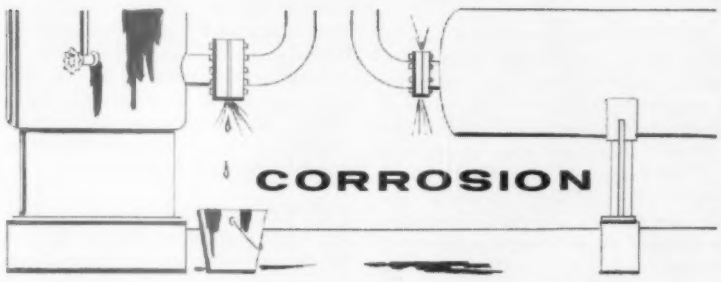
KERSEY: Information we've seen indicates that if you are already reforming your C_7 fraction, you are looking at reforming C_5's and C_6's and the octane improvement is not enough to justify the reforming cost and the yield losses.

BANKS: What is the effect on reformate octane, F-1 clear of lowering the i.b.p. from 200° to 150° F.

CHAMBERLAIN, W. C.: This is our question. We think that it costs you about 2.5 clear numbers. We can include a little more comment on the thing, but we were looking to see if anybody could agree with the information we have. I would like to ask Mr. Rose one short question: On this "no loss of activity" on your units, what happens to your temperature profiles in your reactors, or do you run them?

ROSE: Yes, we do run them. We

run temperature profiles several times a week. We have automatic data logging, and are set up to punch out profiles very easily. Our profiles have changed very little through the runs that we have had.



BANKS: Has there been any marked progress in reducing fouling of pretreater (or hydrogenation unit) feed exchangers in the last year?

HARRELL: Marked progress has been made in reducing fouling by excluding oxygen from feed. Widespread use of gas blanketing for tanks or taking feed directly from crude unit has made excellent improvement.

In cases where it has been impractical to operate in absence of oxygen, Polyflo 100 has been used to excellent advantage. Many pretreat units are operated full run schedule with Polyflo 100 in feed where unit did plug after 3 or 4 weeks of operation.

Use of Polyflo 100 has permitted inclusion of cracked gasoline in charge to pretreat units. Several refiners use Polyflo only when cracked gasoline is added to pretreat feed.

Polyflo 100 has been used to prevent increase in pressure drop across reactor in pretreat unit. Dosage of Polyflo used is same as in prevention of preheater fouling, approximately 20 p.p.m. by weight.

BROOKS: I would like to echo Mr. Harrell's position on the benefit of gas blanketing. It has certainly been effective and beneficial in reducing fouling in the preheat exchangers. I want to report on an additional observation. One of our subsidiaries, American Oil, at Yorktown, processes a significant amount of cracked stocks into their pretreater—up to 70%, on occasion—and they had a very severe fouling problem in their heat-transfer exchangers and in the furnace.

About the first of this year, they started a test adding a Nalco O-1537S antifouling agent. With this material, and at about the same order of magnitude that Mr. Harrell talked about in the addition in the feed, they have no decline in heat transfer in the exchangers, or in the furnace, in over 900 hours of operation. They are continuing in this operation with excellent heat transfer in the exchangers, and no fouling or loss of furnace tubes.

KILLEN: We think we have seen an improvement on one of our units where we are just feeding a virgin stock by raising the initial of the feed, strangely enough, from 200° to 220° F. It seems to have reduced the fouling, but we aren't sure. I wonder if anybody has borne that out, with a similar virgin stock?

HARRELL: I can't answer your question directly, because there are so many variables involved. Another thing, along that line, you can have two units, operating side by side, and the unit you think should foul, won't, and vice versa. There have been many theories brought up on what the mechanisms of these reactions are.

ROSE: It is pretty hard to find a consistent reason for any of these things happening; what works for one fellow won't work for another, and so on. Last year, at this meeting, I described a problem we had at our reformer pretreat, where we were trying to pretreat straightrun intermediate naphtha and a coker gasoline in combination. The intermediate naphtha was stored in a floating-roof tank and was taken from there to an oxygen stripper, which we had every reason to believe was operating well; we sampled streams for oxygen, with the help of Sun Oil Co.; and we were fairly sure the tower was doing the job. The coker gasoline was going down hot from the coker fractionator, so there was no chance for oxygen to get in there; yet we had two very sad experiences, losing exchangers after runs of about 17 days and 12 days.

What we are doing now, and fairly successfully, is taking the coker gasoline on down to another one of our trains in a mixture with light coker gas-oil. In this unifining train, we treat it with light cat gas-oil. We've had no problem. A thing that stands out is that in our reformer pretreator, the hydrogen joins the charge before heat exchange. In the train in which we are processing the material successfully now, the hydrogen is heated separately and joins the hydrocarbon in the top of the reactor. Now I am sure there are some people in audience who can stand up and give you an exactly opposite experiences, so it is pretty hard to come to a consistent reason for any of these things.

HARRELL: They may be all different, but it all looks like the same fouling, essentially. The use of cracked gasolines in with the charge does seem to be a slightly different problem—not that it lays down a different type of fouling, and not that it occurs in a different way. It is, in a lot of ways, directly proportional to the amount of cracked gasoline that goes in feed. By regulating the amount of cracked gasoline that you use in the feed, a lot of times you can find an operating point that you can tolerate. Use of the dispersant additive in 20 p.p.m. concentration in total feed permits you to increase percentage of cracked gasoline several times above that normal.

ROSE: Actually, we found that the fouling materials are almost always 90% or more of iron sulfide. That is a pretty straight-forward reaction. You take H_2S and iron at certain temperatures and you're going to get iron sulfide. I believe Ohio Oil did some work some time ago and found that oxygen contributed to polymerization of certain sulfur compounds..

BROOKS: This is a problem that everybody seems to have, and I agree that it is not associated with the catalytic process, but a function of just merely heating naphtha. In response to your question about the mechanism, we have a definite theory that it is catalyzed by the presence of iron oxide and iron sulfide which is coming in with the feed stocks. Some studies made recently have shown that our naphthas can hold, frequently, from 1 to 10 p.p.m. of iron oxide and iron sulfide. Moreover, this material is extremely fine.

Our analysis shows this material to be in the 0 to 5-μ range. This is almost impossible to pick up with the filters that we currently know about, and yet it is going into our preheat exchangers, into our furnaces, and into our reactor beds, fouling them and plugging them up. And if we can get them out of the feed, I think we will certainly reduce the fouling problem very significantly.

HARRELL: Do you have any theory on where the iron originates?

BROOKS: We think it originates in tanks, lines, and crude units. One of the ways to attack this may well be corrosion protection in the crude units and in the rundown lines.

ROSE: You receive your crude in iron ships, you pump it through iron lines with iron pumps, you store it in iron tanks, and process it in crude units made of iron; that's where your iron comes from.

HARRELL: The corrosion inhibitor you use on your unit, though, should protect all those points down the line.

ADAMS: Why don't you see if you can develop a magnetic filter to get all these iron particles out? Have you ever worked on that?

BROOKS: I understand that there are magnetic filters available. I have no specific information on them, but I have heard that CUNO has a magnetic filter that will pick up particles in a 0 to 10-μ range.

KILLEN: Could that 0 to 10-μ iron you are talking about be in solution in the oil?

BROOKS: No.

KILLEN: The theory has been raised, I think, that the alkalinity of the oil will affect the amount of iron that the oil can actually hold in solution. Has anyone done any work along this line? I think some of Ohio Oil's work raised this possibility.

BELL, J. C. (Atlas Powder Co.): We are making a study now on two plants regarding this iron we have been talking about, in the feed stocks, and it will probably be another 2 or 3 months before we have any definite information on this, but it does look particularly good at this time. We have reduced the amount of iron in the stocks, but we do not want to get too far ahead right now. When we get a little more information, we will be glad to pass it along.

HARRELL: One comment that should be made on the additive, is the fact that we believe it could be outranged by very large oxygen content. So, if you have a problem and you try additive to stop it, look over oxygen concentration and conditions. You may want to try some of the other things like feeding directly from the unit, gas blanketing tanks to an extent, keeping your charge stock as fresh as you can, and giving the additive a chance. With all of these things working together, you have roughly a 99% chance of succeeding.

KILLEN: You have to be careful about calling the additive man a liar when he tells you what was wonderful in somebody else's plant. In our own, where we have a very bad stock, about 8 or 9% coker, we have an additive that increases our run length from about 12 days to about 10 weeks. We take that additive and put it in another plant where we just have a virgin stock and not even a high end-point stock, and it doesn't do a bit of good. So, this just bears out what Mr. Harrell said, that even though it works under one set of conditions, it doesn't necessarily work for somebody else.

ALEXANDER: I think we have about the nicest solution to the problem—we've got dual exchangers, and we pull one off the line and clean it while we're on stream.

HARRELL: Don't oversell that, because if you examine your maintenance cost, the use of additives may beat the maintenance cost.

BANKS: What is the best way to prevent plugging of equipment with ammonium chloride in catalytic reforming units?

KERSEY: We had considerable trouble with ammonium chloride deposits plugging up our stripper and our stripper feed coolers of our desulfurizer. They were bad enough for a time to shut us down about twice a month for cleanout. We have no separator between the feed coolers and H_2S stripper so a continuous water wash could not be used. We found the best way to solve this was to keep the chloride out of the feed. Most of use are aware that chlorides come in from organic solvents used in well treating. We wrote letters to all of our potential crude-oil suppliers, and requested that the use of organic solvents be eliminated. This was pretty effective in reducing our deposit trouble.

ADAMS: This can be handled by water washing in the final exchanger cooler, and then removing the water from the separater or receiver. This may lead to corrosion problems and will require neutralizers and inhibitors, and gives you a soaking-wet recycle gas, so this presents still more problems. In our reformers, we have installed pretreaters to try to eliminate this material entirely from the reforming units. So we now have these problems with the pretreating units.

BROOKS: We have had corrosion and plugging problems in the debutanizers in some of the Ultraformers and have found that Nalco corrosion inhibitors (Nalco 161) added into the debutanizer overhead which gets back into the tower through the reflux stream, has materially reduced the fouling in the debutanizer from ammonium chloride deposits.

RULIS, A., (Cities Service Oil Co.): Have you had any trouble in the compressor cylinders, on recycle gas compressors, with ammonium chloride plugging?

BROOKS: Yes. Some of the recycle gas compressors have been fouled with ammonium chloride deposits, and the only solution that I know is to shut down and wash out with water. I don't know of any antifoulant or inhibitor which is helpful here.

BANKS: What is the box score for materials from which reactors are built? (How many are of carbon steel, carbon moly, 1% chrome, etc.)?

WRIGHT: We have carbon-steel reactors.

ROSE: The Tidewater Delaware City units, like all other Houdry units, I believe, except for one, are A301, Grade B, unlined.

JOHNSTON: A204, Grade B, FBQ carbon steel, ½% moly.

VERITY: Our normal practice is to use carbon steel.

ALEXANDER: We have lined carbon-steel reactors. I think we could have saved the money spent fooling around with them if we had put in alloy there, and been done with it.

KERSEY: We have A206, Grade B Firebox quality steel in our reactors, lined. We've had no trouble with the lining, yet.

ADAMS: We have some of each; two units have externally insulated alloy reactors, and one is carbon steel with internal insulation. We are considerably happier with the alloy ones, because we don't have to maintain the lining.

ZANDONA: We have three units, and all three of those units are A301, Grade B. We've had inspections after periods of operation of at least a year, and have shown no signs of corrosion in any of the reactors.

Use of TEL in U. S. gasolines (approximate)

TETRAETHYL LEAD has since 1933 been one of the most useful additive agents. Lead additions have been the cheapest way to obtain the last 8-13 units of octane number (research method). According to Table 1, tetraethyl lead has been used to increase the research octane number by about the amounts shown at right.

	Cc. TEL	Octane number—Finished	Octane number—Rise	Cents per O.N. barrel
1933	0.75	66.0	10.0	1.5
1930	1.8	*72.5	*14.5	3.4
1939	1.05	73.5	10.5	1.1
1931	1.85	*74.5	*13.5	3.5
1945	1.00	75.5	9.5	0.8
1933	2.15	*79.0	*13.0	3.5
1943	0.85	80.2	8.2	0.8
1945	2.15	*80.6	*13.1	1.2
1939	2.45	*82.4	*12.4	2.1

*Premium grade.

	Cc. TEL	Octane number—Finished	Octane number—Rise	Cents per O.N. barrel
1950	1.80	83.1	11.6	1.3
1952	1.73	83.7	11.7	1.4
1943	2.25	*85.9	*11.4	1.5
1954	2.12	86.3	11.3	1.8
1956	2.17	89.6	11.6	1.7
1950	2.20	*89.7	*11.7	1.6
1952	2.07	*90.5	*10.0	2.0
1954	2.50	*93.6	*8.6	2.7
1956	2.54	*96.7	*7.2	3.2

TABLE 1—USE OF TETRAETHYL LEAD IN U. S. GASOLINES (APPROX.) SINCE 1930

	Octane number—Research Reg.	Octane number—Research Prem.	Octane number—Motor Reg.	Octane number—Motor Prem.	Production, 10⁶ gal.†—Reg.‡	Production, 10⁶ gal.†—Prem.	Production, 10⁶ gal.†—Avia.‡	Production, 10⁶ gal.†—Total	TEL, cc. per gal.**—Reg.	TEL, cc. per gal.**—Prem.	TEL, cc. per gal.**—Avia.	TEL price, cents per ccl.††	TEL consumed—10⁹ cc. fluid/yr.	TEL consumed—Cc. per gal. gaso.	TEL consumed—Cents per bbl. crude
1926	56.1	71.3	56.3	....	.....	....	....	12,600	....	....	....	....	....	....	....
1928	58.3	71.9	58.9	....	.....	2,000	....	15,850	....	¶1.63	....	0.985	....	....	....
1930	61.5	72.5	61.5	70.0	.....	3,000	....	18,150	....	1.84	....	0.655	5.5	0.30	2.7
1931	62.0	74.5	62.4	71.0	.....	2,600	....	18,100	....	1.91	....	0.611	5.0	0.28	2.2
1932	62.0	76.5	62.4	72.0	.....	1,600	40	16,500	....	2.22	....	0.552	3.6	0.22	1.5
1933	66.0	79.0	63.3	73.1	4,000	800	40	16,850	0.75	2.14	....	0.500	4.8	0.28	1.9
1934	69.5	78.0	69.0	75.0	11,200	600	60	17,500	0.76	2.27	2.55	0.327	10.0	0.57	2.5
1935	71.5	77.8	69.0	75.0	12,000	800	60	19,230	0.79	2.28	2.55	0.297	11.4	0.59	2.55
1936	71.5	78.0	69.2	76.1	12,451	781	67	21,200	0.83	2.29	2.45	0.27	13.3	0.63	2.7
1937	72.0	80.3	70.0	76.4	13,438	1,055	82	23,450	0.91	2.36	2.60	0.26	14.9	0.64	2.7
1938	73.0	82.5	70.5	78.4	13,635	1,359	98	23,400	0.91	2.40	2.75	0.25	15.9	0.68	2.85
1939	73.5	82.4	70.7	79.0	15,142	1,897	117	25,050	1.06	2.43	2.75	0.255	21.0	0.84	3.95
1940	76.0	82.4	73.6	79.8	17,591	2,271	177	25,100	1.37	2.50	††3.04	0.237	††30.2	1.20	4.7
1941	80.3	85.9	74.1	80.2	20,130	2,804	414	28,200	1.48	2.55	††3.10	0.208	††38.2	1.36	5.2
1942	80.4	85.0	73.8	79.0	16,604	3,285	1,086	24,650	0.83	2.13	††3.65	0.185	††24.8	1.00	2.8
1943	80.2	85.9	72.7	77.7	13,444	4,843	2,264	24,900	0.89	2.27	††4.00	0.18	††32.0	1.29	3.6
1944	75.8	82.9	72.1	77.7	14,472	5,380	3,402	30,350	0.80	1.97	††4.50	0.18	††37.5	1.23	3.9
1945	75.5	80.6	70.3	74.3	15,877	6,390	2,512	32,500	1.01	2.19	††4.40	0.18	††41.1	1.26	4.0
1946	82.0	88.6	76.3	82.7	15,914	10,845	406	31,400	1.13	1.53	3.40	0.18	36.0	1.15	3.5
1947	78.7	85.7	75.0	80.0	18,567	10,821	619	34,200	1.25	1.55	1.78	0.18	44.1	1.29	4.05
1948	80.2	87.8	76.4	82.2	21,413	10,713	884	37,600	1.53	1.97	2.78	0.193	56.4	1.50	5.1
1949	79.9	88.0	75.8	81.0	23,005	10,711	861	39,400	1.64	2.08	2.97	0.209	62.5	1.59	5.75
1950	83.1	89.7	77.8	81.6	26,839	10,609	1,115	41,900	1.90	2.27	2.99	0.205	78.4	1.87	7.1
1951	83.8	90.7	78.7	82.5	28,991	11,510	1,972	46,500	1.66	2.02	2.97	0.23	77.2	1.66	7.25
1952	83.7	90.5	78.7	82.4	30,035	12,991	2,311	47,950	1.82	2.16	3.28	0.23	90.2	1.88	7.85
1953	85.3	92.0	80.1	83.2	31,158	13,786	2,712	51,800	2.06	2.39	3.35	0.23	106.1	2.05	8.95
1954	86.3	93.6	81.0	84.5	31,740	14,457	2,597	51,800	2.13	2.50	3.28	0.224	112.2	2.17	8.85
1955	88.0	95.4	82.2	85.5	33,891	15,617	2,768	55,900	2.17	2.51	3.31	0.215	122.0	2.18	8.9
1956	89.6	96.7	83.5	86.6	35,124	16,535	2,815	58,100	2.26	2.54	3.38	0.218	130.9	2.25	9.85
1957	91.1	98.4	83.9	87.8	37,350	19,750	§3,100	§60,200	2.02	2.51	....	0.221	§137.2	§2.28	10.5
1958§	91.8	98.9	84.1	88.1	35,200	19,500	3,300	58,000	1.96	2.58	....	0.218	130.2	2.25	10.3
1959§	92.5	99.4	85.1	99.7	.....	.....	3,400	61,000	1.75	2.53	....	0.218	140.0	2.03	10.3

*Ethyl Corp. and Du Pont reports, and Edgar, G., Tetraethyl Lead "Progress in Petroleum Technology," New York meeting, Sept. 1951, of ACS; Frey, J. J., The Plus in Premium Gasoline, API meeting, Marketing Committee, St. Louis, May 10, 1950; Holiday, W. M., Advances in Petroleum Refining, Petroleum Refiner, Sept. 1950, p. 77; Macauley, J. B., Advances in the Use of Tetraethyl Lead, Third World Petroleum Congress, Section VII, The Hague, 1951; and private communications.

†Edgar, G., Tetraethyl Lead, "Progress in Petroleum Technology, p. 221, New York meeting ACS, Sept. 1951; and Ethyl Corp. yearly report on gasoline sales (1956).

‡Only the leaded gasolines.

§Estimate. ¶1929, not 1928.

**Ethyl Corp., USBM and Du Pont reports.

††TEL content apparently applies to military aviation fuels. Accordingly, the total cc. consumed was reduced by estimate.

‡‡Process Costimating No. 58, The Oil and Gas Journal, Oct. 12, 1959, p. 186.

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Members of an NACE panel composed of experts on various phases of corrosion mitigation, answered questions prepared in advance by pipeliners attending the 3-day short course in Tulsa, sponsored by the Tulsa Section of NACE.

Pipeliners answer corrosion questions

BY GENE KINNEY
Assistant Pipeline Editor

Q—Is leapfrogging of electrodes in electrical potential surveys a requirement?

A—It is not a requirement. It was once thought that this practice would eliminate "drift," preventing electrodes from getting out of balance. But electrodes do get out of balance. They must be checked. Electrodes can be out of balance 2, 3, or 4 mv., however, without causing serious trouble. You are looking for patterns. So 2 to 4 mv. are not important numerically in the pattern. Leapfrogging is a time-taking procedure that is not necessary.

Q—How do you balance two copper-sulfate electrodes?

A—The field procedure is to place the electrodes together and observe the potential difference with a potentiometer. If they are out of balance (2 to 4 mv. is not alarming for use on a surface potential survey), unscrew the copper rod from the electrode, shine up the copper rod with emery paper, and replace the copper sulfate if necessary.

Q—How do you calculate groundbed resistance in advance?

A—For a rectifier installation, if the bed is vertical, you should megger soil resistance to varying depths to determine soil resistivity in ohm-centimeters. This value with application of Dwight's curves gives the average resistance of the rectifier ground bed. There are published curves (Dwight's) which give calculations. But depth of burial, which is not taken into account in the published curves, also is a factor. Usually, at great depths, anode resistance to soil is approximately half that of the same anode at the ground surface.

Q—How widespread is the use of litmus paper to check the chemical analysis (base or acid) of a bad spot on a pipeline?

A—Only one pipeline company (Shell) is known to use litmus paper. Maintenance crews carry small boxes of litmus paper to test, particularly under bonded coating where moisture is trapped. If the moisture turns the paper red, and the line is under cathodic protection, then the pipe at this point is actually not being protected. The area around a protected line should be alkaline. It is important to make the test immediately after a line is dug up before contact with the air causes a change.

Q—What is the reason for insulating the carrier pipe from the protective casing at a highway or rail crossing?

A—There are two reasons: (1) You can't extend a coated pipe through a casing without damaging the coating, unless insulators are used every 10 to 14 ft. The drag section can be pulled through the casing without touching and so avoid damage; (2) isolation is the other reason. If you can keep coated pipe from touching any foreign object (another pipeline, casing, bridge, etc.) cathodic protection will be cheaper. Every time the pipe touches a foreign structure, it

costs more for cathodic protection, for it is lost on the foreign object.

Q—What is the purpose of a center cradle on a cased crossing?

A—It is an effort to center the drag section at casing ends. Also the use of insulating cradle at the end is for a more economical approach.

Q—How do you locate shorts in cased crossings? What do you do about them?

A—Most shorted casings are at the end, but often the trouble is toward the middle and can be hard to pinpoint. One method is to pull a shoe through the annulus to clean it out, then pull through a string of insulators. When the job becomes quite expensive, other measures, such as installing anodes on the casing, are taken. One example cited was a 300-ft. casing which had a short; the pipeline had appropriated $8,000 for repair. The job was actually done for $2,000. The short was located by subsurface potential measurements under the highway, and crews were able to dig down and repair it.

Q—What are the general recommendations to guide maintenance crews in protecting hot spots on bare pipe without the benefit of instruments when lines are exposed for repair?

A—The general rule is: Every time you repair a pit-hole leak, install an anode. If the pipe corroded once, it's likely to corrode again without cathodic protection. One practice when replacing a section of pipe is to apply a cold coating, then install one to three anodes, depending on the situation. In all cases whether a crude oil or products line, clean the pipe with a wire brush or solvent before coating. Replace the backfill with clean soil.

Q—Discuss management thinking on interior pipeline coatings.

A—Interior coatings with plastic are becoming widely used on gas lines. They permit increased throughput with a smoother surface, and also result in fewer pig runs. Industry tests have disclosed efficiency increases of 1 to 5% from internal coating of gas trunk lines. Internal coating has proved economical in severe sour-crude service when uncoated steel lines have developed pit leaks in a matter of months. It has also been beneficial in reducing paraffin deposition in flow lines. The economics of internal coating on sour-crude or gas-gathering lines is complicated by the length of time the lines are expected to continue in service. Plastic-coated lines have been in service 5 to 7 years in West Texas with good records.

Q—What is the minimum desired spacing of test points on crosscountry and gathering lines?

A—Spacing of test leads depends on the quality of coating. A good minimum to aim at is to test leads no more than 2 miles apart. In an industrial area, leads may be as close as ½ mile. Accessibility is a factor. One practice is minimum 2-mile spacing and leads at all casings, and at any foreign crossings. Use of test leads and cathodic protection on gathering lines is not widespread.

Q—Explain the test for green or dead primer.

A—If your thumb, under easy pressure, leaves slight imprint in the primer, and your thumb is not stained, it is all right to go ahead with coating. If the primer crumbles and powders under a knife blade, it is dead. If it curls like a spring, it is still good. There has been a tendency in the industry to apply too much primer under enamels.

Q—How reliable is a pipe-to-soil potential in determining protection after cathodic protection has been applied?

A—Pretty reliable. It is an accepted standard by most corrosion men. Electrode placement is important. Keep the reference electrode close to the structure being measured.

Q—When there is a problem of shielding, why not go to deep-type ground beds?

A—Deep ground beds directly under the pipelines involved proved to be the answer for one company with 13 lines in one right-of-way which was shared by four other pipeline companies. The center line was shielded and had leaked. The deep ground bed, however, spread current over all of the lines. The bed was 20 ft. under the pipelines.

Q—What is the corrosion phenomenon under coating at a spot where the bond has been lost?

A—It is usually a corrosion concentration cell. Corrosion can occur under mill scale. Water under the coating becomes more alkaline and less corrosive.

Q—What is the best spacing for (impressed current) anodes?

A—Some use 20-ft., others 30-ft. minimum spacing. You should take into account soil resistivity.

Q—How do you solve problems of ground beds in dry areas?

A—One company has this problem only 30 miles from the Gulf Coast. It is hauling water to the ground bed in dry periods. Another company reports that its experience dictates against watering. The reason is that wetting only aggravates the situation; when the ground bed dries, it dries harder than before. This company suggests it would be better to cut back the current. Installing more rods is one means of getting more uniform operation over wet and dry periods. One company puts crude oil around an anode so that moisture will move toward the anode and hold there. Another company has found that this won't always work.

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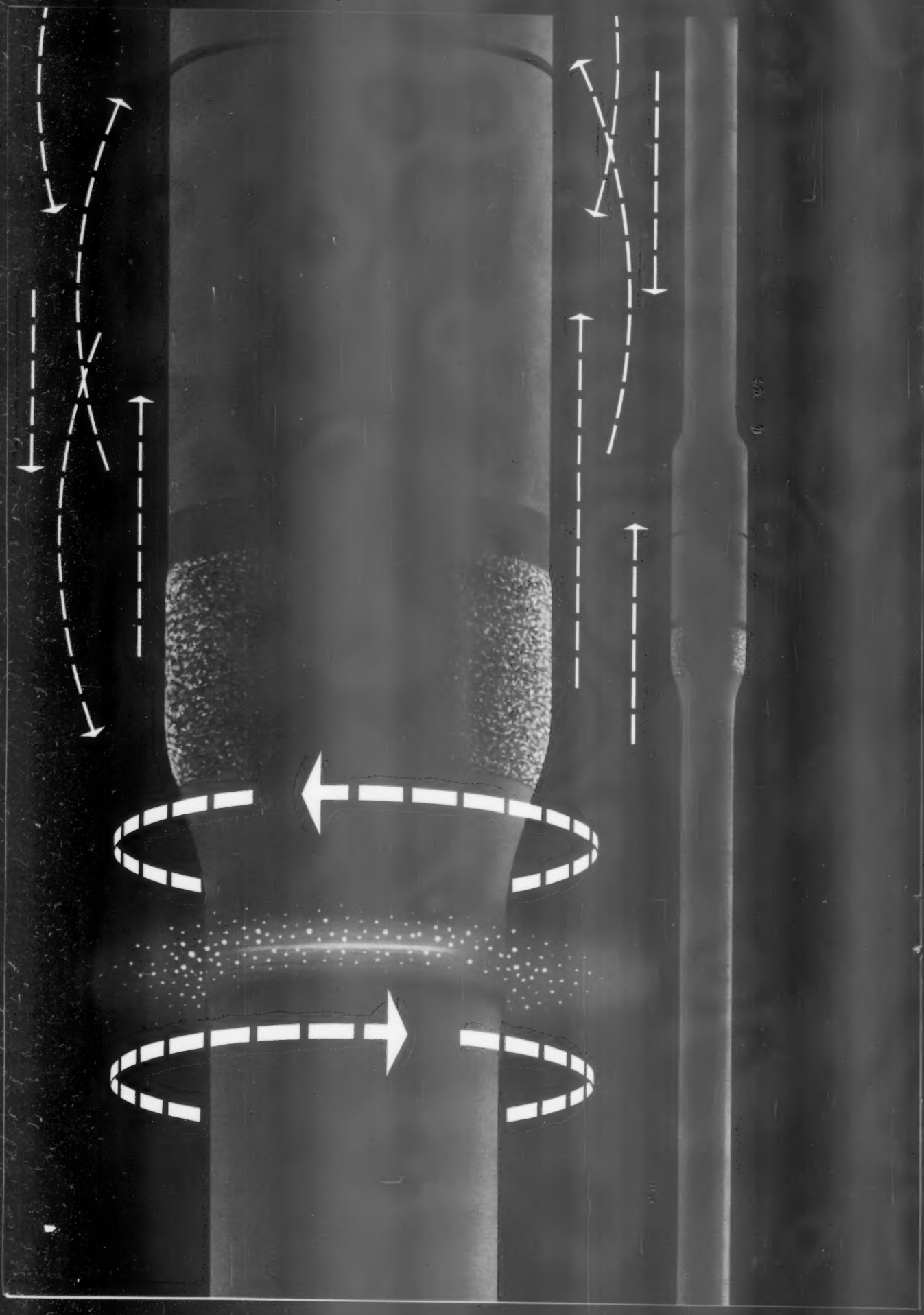

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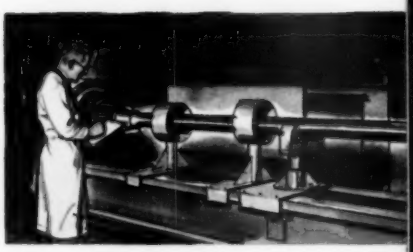

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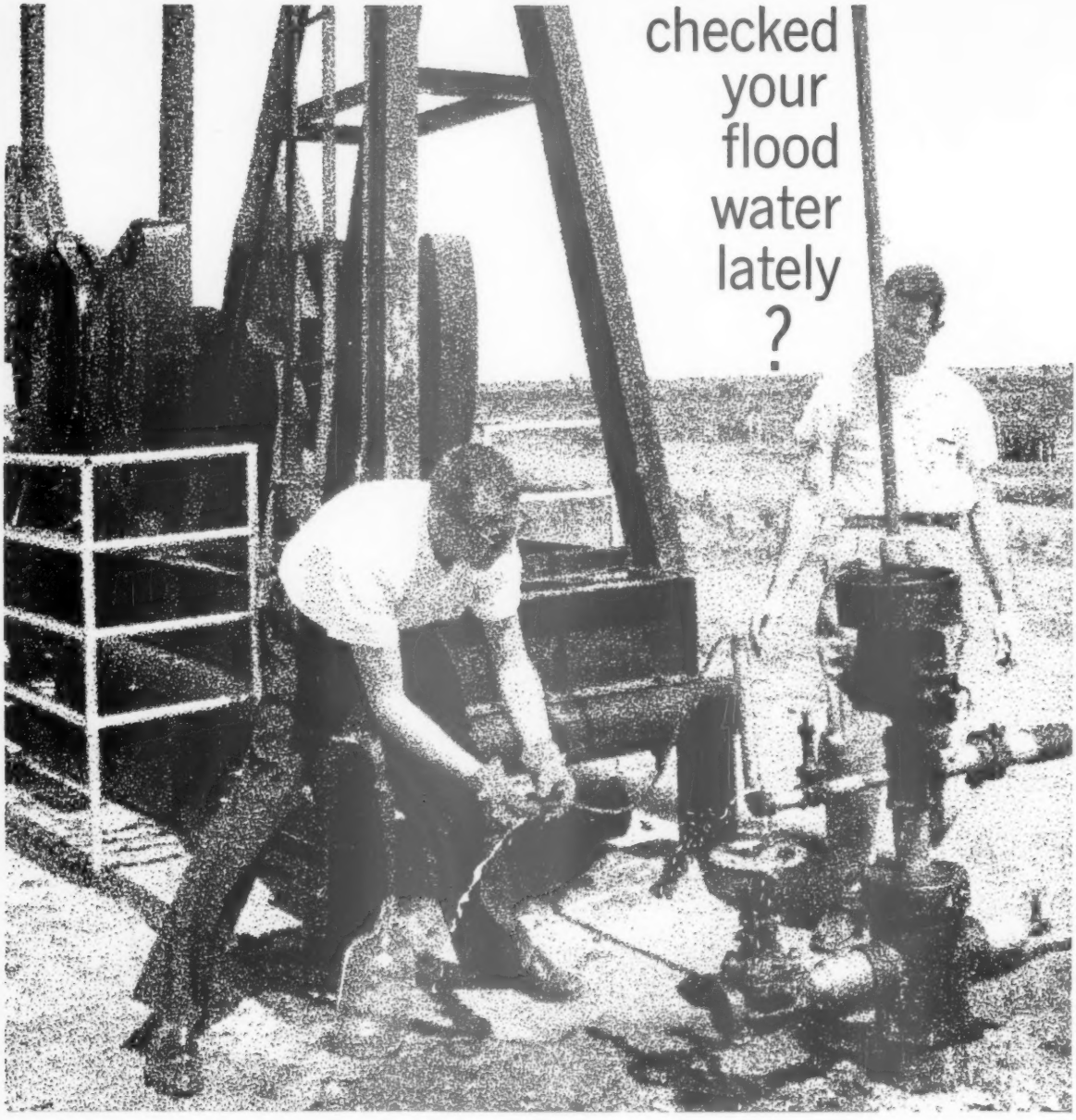

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The new loader is expected to provide high productivity. Features include a power-shift transmission which permits fast shifting into forward or reverse. The hydraulic system is designed to deliver full power during critical loading phases.

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The front tires are the forward-most portion of the machine frame to do away with the risk of damage to truck bodies by contact while loading takes place. Two control levers control machine direction and speed. Approximate price, f.o.b. factory: from $17,950 for a gasoline-powered Series A machine to $20,350 for a diesel-powered Series A machine. Source: **Caterpillar Tractor Co., Peoria, Ill.**

HOLDING A LOAD at full lift height of 12 ft., Trascavator moves to dump the load into a transporting vehicle.

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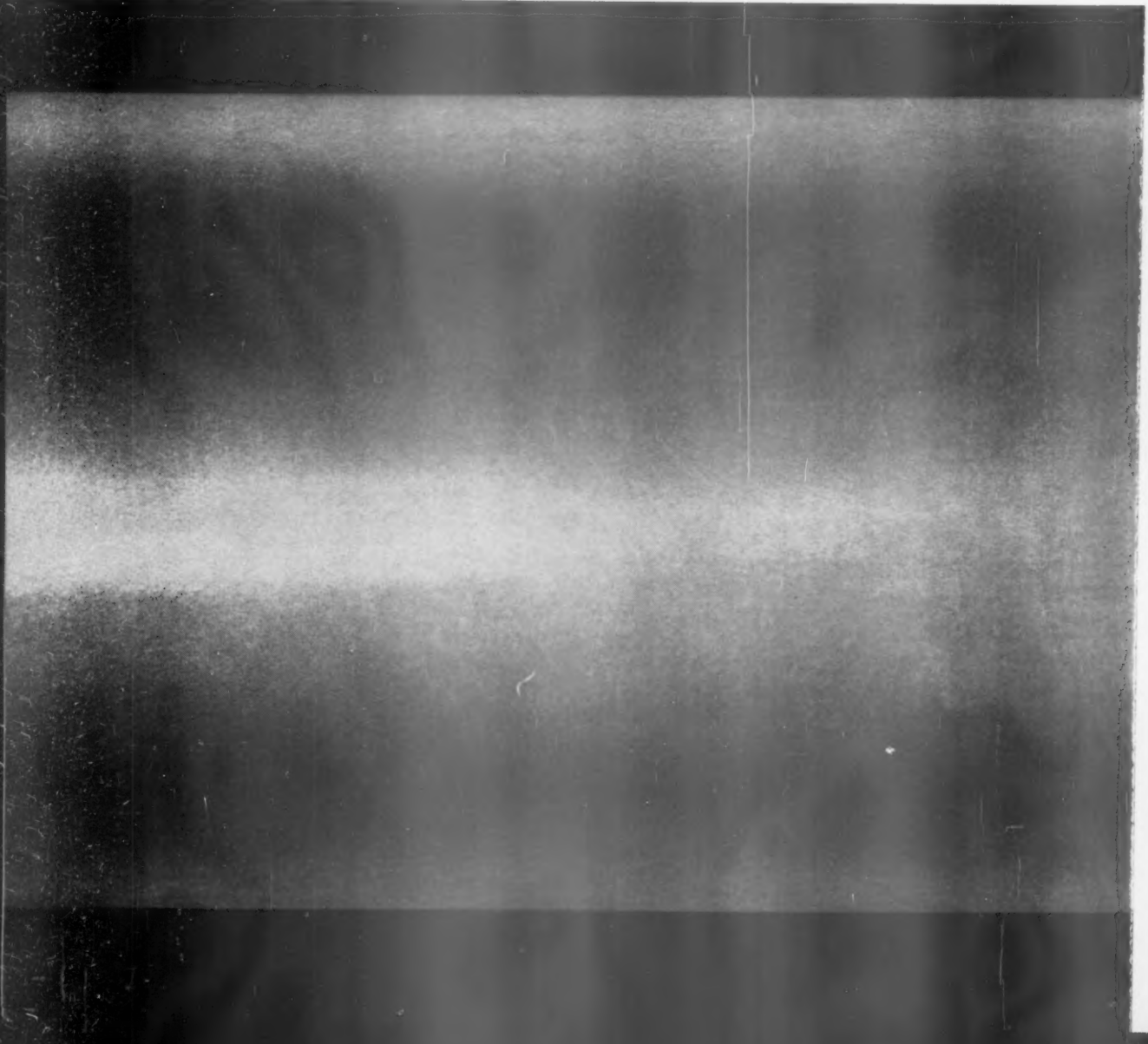

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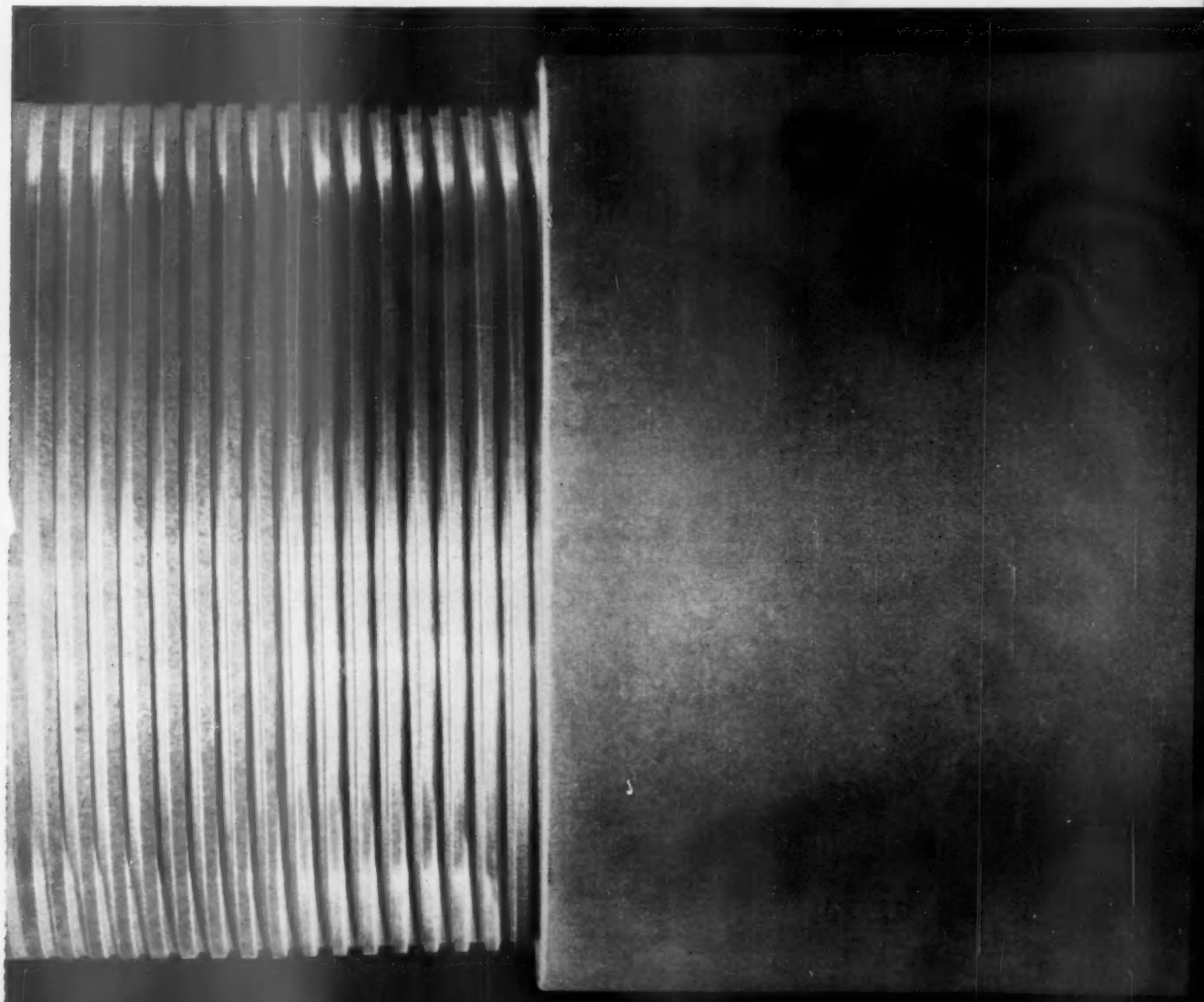

REPUBLIC ALLOY STUDS AND HEX NUTS provide powerful clamping action that assures safe, leakproof performance on high-pressure applications. Studs are usually furnished in AISI 4142 Chrome-Moly Steel, heat treated to ASTM A 193, designation B 7, or in designations B 14 and B 16 for higher temperatures. New folder has complete information. Return coupon for your free copy.

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REPUBLIC SRK PLASTIC PIPE is ideal for many oil field jobs. Unaffected by crude oil, brine, or gas, this semi-rigid plastic pipe costs no more to buy than ordinary pipe. Joining is fast and easy with brush-applied solvent and plastic fittings. Available in a wide range of pressure ratings and sizes from ½″ through 8″, SRK Plastic Pipe cuts with a handsaw. Can be installed in combination with metal lines. Send for details.

REPUBLIC ALLOY STEELS offer outstanding strength-to-weight ratios with the highest strength values. Uniform response to heat treatment assures complete deep-hardening penetration, plus hard, wear-resistant surfaces. Republic field metallurgists can help you select, process, and apply the alloy steel best suited to your requirements. Mail coupon for data.

REPUBLIC STEEL CORPORATION
DEPT. OG-8940
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Please send more information on:

- ☐ Republic Buttress-Thread Casing
- ☐ Alloy Steels
- ☐ Studs and Hex Nuts
- ☐ SRK® Plastic Pipe

Name_____ Title_____

Company_____

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City_____ Zone____ State_____

REPUBLIC STEEL

World's Widest Range of Standard Steels and Steel Products

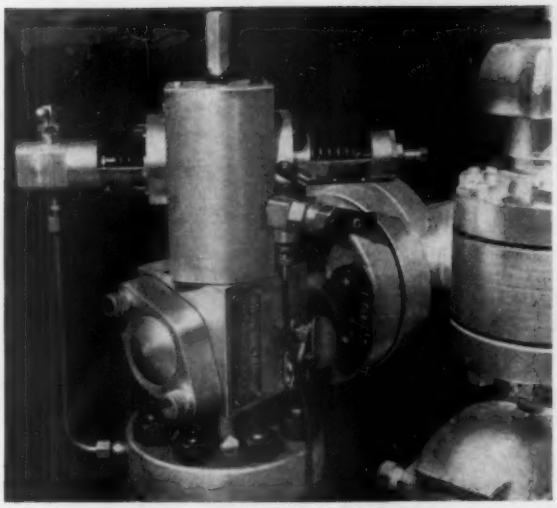
$7.50 for 1 gal. to $3.95 for large quantities. Source: **Omega Co., Inc., 1539 Harbor Avenue, Long Beach 13, Calif.**

•

Tank vent valve

. . . offers a number of features worth noting as compared to older types. The Fig. 2000 Series combination pressure and vacuum conservation vent valve reportedly features better sealing, lighter weight, and increased capacity. A new pallet insert, trade named Air Cushion, has also been introduced.

The seal between the pallet and the seat ring is effected by a soft and pliable material cushioned against an air pocket. According to the manufacturer, flexibility of the seal assures against icing, provides a more sensitive and positive sealing surface resulting in an improved balance between the intake and exhaust. Solid type of plastic seating inserts are available. An aluminum hood has reduced the overall weight about 20% and increased flow capacity as compared to older types. Delivery: 3 weeks. Approximate price, f.o.b. factory, ranges from $40 for a 2-in. up to $290 for a 12-in. size. Source: **Vapor Recovery Systems Co., 2820 North Alameda Street, Compton, Calif.**

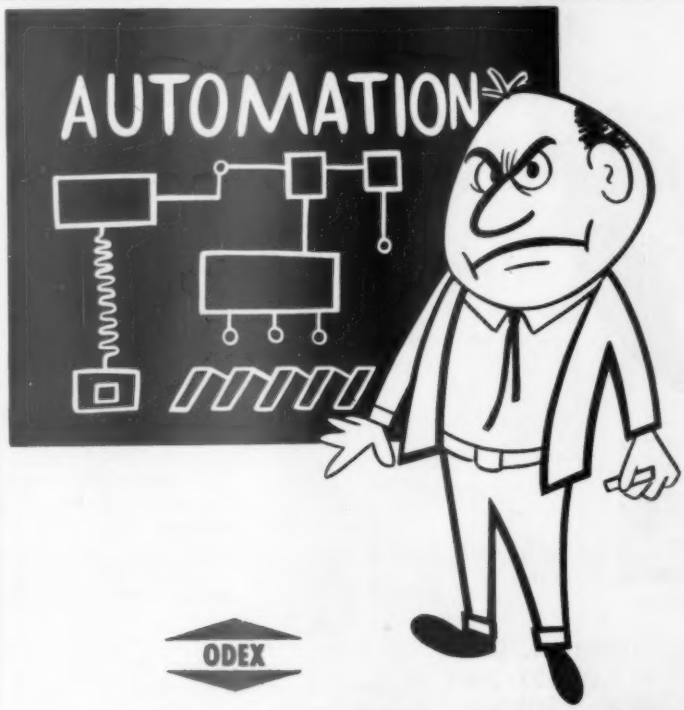


New safety shutoff valve

. . . just put on the market, called the Hi-Lo safety shutoff valve, tests both the high and low valve-pressure settings without having to shut in the well. The design, according to the manufacturer, enables the valve to reset itself with live pressure and to work with pressure rather than against it.

The maker also points out that the valve eliminates the need for a screw-jack resetting and for auxiliary pressure accumulators. The valve can be adapted for remote control and for high-fluid-level shutoff.

Pressures from 35 to 10,000 psi. are handled safely, the maker claims, due to the valve's rugged construction. Shutoff is achieved by a pressure-energized piston with Teflon seats. This piston is actuated from an opening in a stainless-steel piston valve with Teflon insert seats and adjustable pressure-control spring. Delivery time is about 10 days. The valve comes in



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sizes to fit any API flanged or screwed connection. Approximate price, f.o.b. factory, is $525. Source: **Willis Oil Tool Co., 2451 Palm Drive, Long Beach 7, Calif.**

•

Close control

. . . accuracy to within ½ psi. is provided by a new air-adjusted pressure pilot now available. The accuracy is provided from positive pressures through the vacuum range to 30 in. mercury. The pressure pilots can also be used with a temperature recorder-controller for control of process temperatures, according to the maker.

Designated the A80 series, the pilots permit remote air loading for centralized control by locating the pressure-adjusting panel at any convenient distance from the regulator. Depending upon the type of pilot chosen, the delivery pressure is changed by 1 to 2⅔ psi. for each 1-psi. change in air-loading pressure. The pilot has a bronze diaphragm. Delivery: 2-4 weeks. Approximate price, f.o.b. factory: from $28.80 to $106.20. Source: **Spence Engineering Co., Walden, N.Y.**

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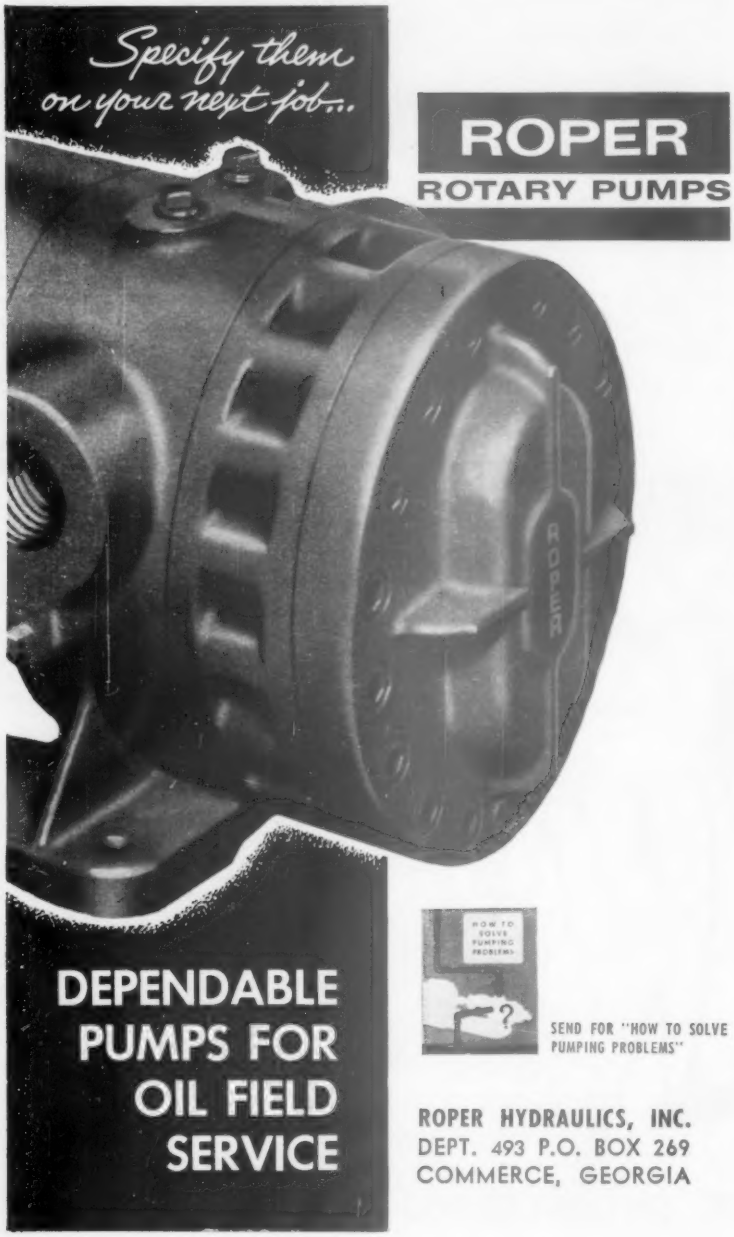

Fluorescent fixture

. . . for outdoors or indoors use is weatherproof, sturdily constructed, and has a shatterproof plastic lens. Housing is an extruded-aluminum channel with cast-aluminum end caps. The door opens quickly. Just turn three catches.

The reflector fastens securely and removes quickly without the use of tools because of a continuous flange fitting into a continuous groove in the housing. All alloys are corrosion-resistant, and all joints are gasketed. When the Type HLG fixture is mounted on a ceiling in continuous rows, the wide light distribution provides some light on the ceiling. Delivery: 4 - 6 weeks. Approximate list price, f.o.b. factory: from $220 for a single lamp, no ballast, to $330 for two-lamp, two one-lamp ballasts. Source: **Crouse-Hinds Co., Syracuse 1, N. Y.**

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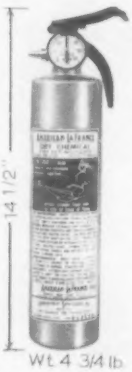
Extinguisher



. . . operated by one hand is now being produced for protection of Class B (flammable liquids) and Class C (electrical) risks. A dry-chemical type, the Model PDC 2½ B extinguisher has the same fire-extinguishing ability as eight 1 or 1½-qt. vaporizing liquid extinguishers, the maker claims.

Pictorial instructions on the unit make it easy to learn operation quickly. When you squeeze the handles together, a penetrating cloud of dry chemical is expelled under pressure to put out a blaze. According to the maker, it is

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PRESSURE GAUGE:

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PRESSURE GAUGE!
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Write for Bulletin No. P-85
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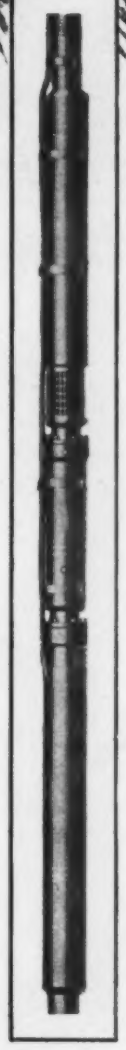

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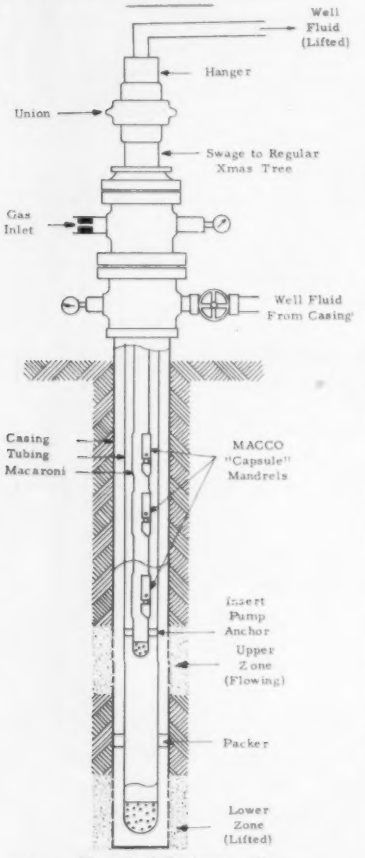
MACCO

MACCO MULTIPLE COMPLETION AND SLIM HOLE EQUIPMENT

The "capsule" type mandrel is available from stock for all standard multiple string, macaroni, and slim-hole gas lift. Special sizes are manufactured upon request. With the valve and check valve mounted inside, this type of mandrel provides extra large flow areas for the well fluids. The producing zones of parallel or concentric multiple completions may be simultaneously lifted by either a "common" or "separate" gas supply. **Macaroni tubing lowered inside of the regular tubing has proved a highly successful means of lifting wells where it is objectionable to pull the regular tubing.** Efficient lift inside of small liners is also made possible.



The casing is flowing naturally. "Capsule" Mandrels are run inside the regular tubing.

Macco manufactures many different types of multiple completion equipment to fit any well requirement. For further information, write for Brochures Nos. 3-12, 3-13, 3-21, 3-31 and 6-12.

MACCO
OIL TOOL COMPANY, INC.
Houston 8, Texas
1521 Prince P. O. Box 7288 Houston 8, Texas
Phone UN 1-1253

approved by Underwriters' and Factory Mutuals Laboratories. Underwriters' rating is 4B:C.

Effective discharge time is 10 seconds. The extinguisher can be recharged by refilling with prepackaged dry chemical and charging it with air or nitrogen at 150 psi. Weight: 4¾ lb. Height 14½ in. Delivery: immediate. Approximate list price; f.o.b. factory: $20. Source: **American LaFrance, Elmira, N. Y.**

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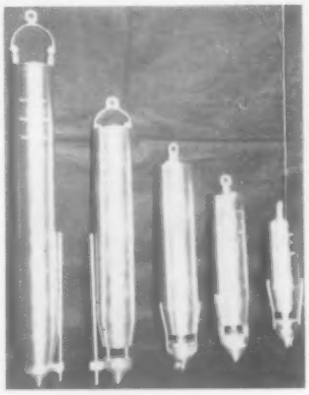

Tank-sampler

. . . adapts to a regular gage line, and no ropes or chains are required to strip it of liquid before reuse. With the Peterson sampler, tanks can be gaged and sampled in one operation, the maker claims. Two basic models are available. Model 10 comes in 8, 10, and 12-in. lengths. Model 96 comes in 12 and 16-in. lengths.

The Model 96 has a locking feature which automatically locks the sampler in the closed position when tripped. The stinger is optional, on the outside or inside. Approximate price, f.o.b. factory: from $39.95 for an 8-in. Model 10 to $45.95 for a 16-in. Model 96 sampler. Source: **P & M Co., Box 152, Dix, Neb.**

●

Credit-card recorder

. . . the M-103, now on the market sells for $21 each in quantities of 1,000 units. Invoices are imprinted with a quality suitable for automatic reading, the maker says. The unit is designed to prevent invoice wrinkling.

Optional features include dealer or department plate, date-printing device, amount printing, and an inking device. Models are available for use with any size punched card or plain paper invoice sets and for any size credit card. Source: **National Data Processing Corp., Ross at Prairie Avenue, Dallas 21.**

LOOSE SANDS?

SANDBAN
SCREEN

Sandban* screen is a new tool for controlling sand production. Sandban screen consists of a slotted aluminum screen, a smaller aluminum or steel screen inside and a permeable network of plastic-coated walnut shells between the screens. Sandban screen is easy to use—and economical. Available sizes: 4-inch O.D. with 1½-inch steel screen inside; 5⅝-inch O.D. with either 2⅞-inch steel screen or 2-inch aluminum screen inside. Other sizes made to order. Ask a Dowell engineer about Sandban screen.

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Let Rubber Take The Wear

in your sucker rod pumps

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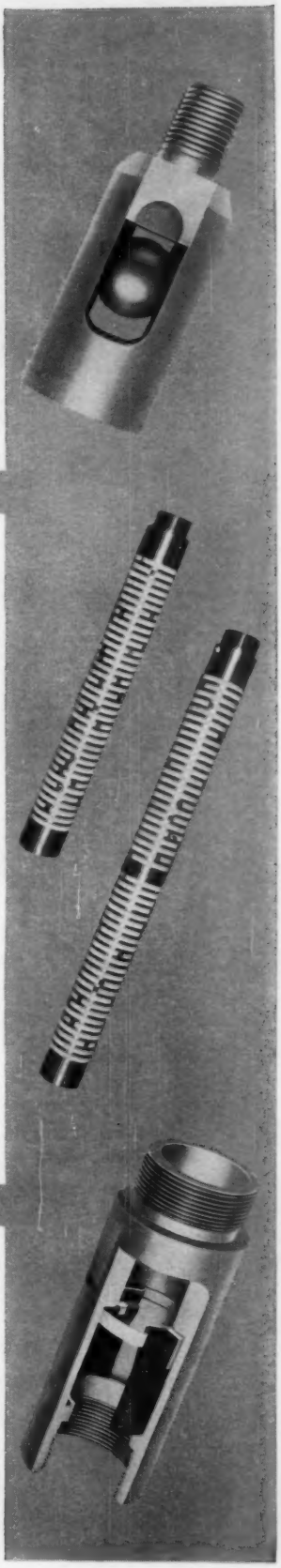

Both **MARTIN PLUNGERS** and **MARTIN RUBBER GUIDE CAGES** are the result of correct engineering to fully utilize the excellent properties of rubber.

In the **MARTIN SPLIT RINGS,** even the swelling of natural rubber in oil is utilized in sealing the split and tightening the rings in the PLUNGER GROOVES. **Resistance to abrasion** greatly prolongs plunger life in sandy conditions. **Slippery when wet** means that you have lubrication, even when pumping all water. Barrel life is increased because this material cannot score or gall metal.

For the **REPLACEABLE RUBBER GUIDES** in cages, **oil resistant** synthetic rubber is used. No swelling can be tolerated here. **Resilience** completely eliminates the beating action of the ball, and greatly increases ball life. **Resistance to abrasion** reduces wear on both guide and ball.

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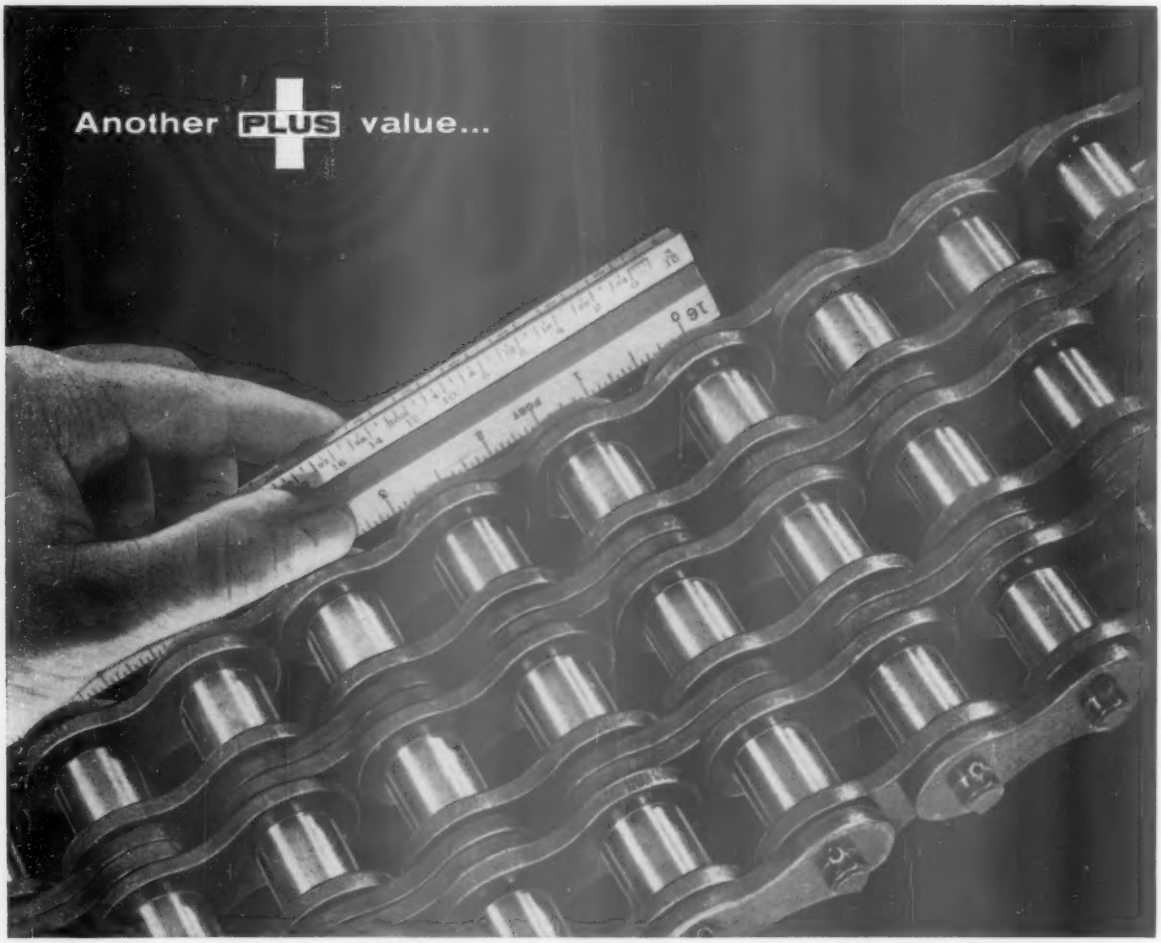

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Accurate control of chain pitch is a *must* to meet the demands of today's drilling service. Variations in pitch cause uneven loading on the chain parts with resultant early fatigue failures.

In Rex Oil Field Roller Chains you get highest fatigue strength because pitch is *accurately* controlled...each link in the strand has controlled pitch as well as the entire strand. Link plates, bushings, rollers and pins are all designed and manufactured to extremely accurate tolerances to assure pitch control *throughout the long life of the drive.*

For longest life...highest fatigue strength, get the chains that give you ALL the *plus* values: Rex Rollér Chains. Available in GLIDE-FIT (cottered) or DRIVE-FIT (riveted) styles. CHAIN Belt Company, 4619 W. Greenfield Ave., Milwaukee 1, Wis.

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SHOWCASE . . .

New Literature

The Pros and Cons of Leasing

. . . is the title of a free publication which contains a complete analysis of equipment leasing. Long-term leasing of production equipment during 1959 spurted ahead, reaching a total of $30.4 million worth of equipment on lease, a gain of 60% over 1958. Since it has been predicted that equipment leasing in the petroleum industry will double in 1960, this publication should prove valuable to interested parties. Source: **Foundation for Management Research, 121 West Adams Street, Chicago 3.**

Film catalog

. . . just published contains lists of specialized business and professional motion pictures about new products, advanced industrial processes, and cost-saving techniques. The films are available on a free-loan basis to groups with specialized interests.

The 16-mm. sound movies, as described in the newly revised catalog, deal with research and development, steelmaking, plastics, die-casting, infrared spectroscopy, compressed-air-power application, forging and grinding techniques, and other subjects useful in construction, chemical, and petroleum industries. Source: **Modern Talking Picture Service, Inc., 3 East Fifth-fourth Street, New York 22.**

Hose, fittings,

. . . self-sealing couplings, and related products are detailed in Catalog 204, just published and obtainable now. The 40-page catalog includes up-to-date specifications on products for use in applications such as mobile equipment, oil-field machinery, and stationary power plants.

The publication also contains descriptive data on adapters, support clamps, and protective sleeves. A hose-selector chart is included listing various applications and fluids for which specific hose types are recommended. Source: **Aeroquip Corp., Jackson, Mich.**

Oil-cooler

. . . Catalog 1059 lists data on oil-to-water oil coolers for torque converters, industrial application, and marine transmissions. Information in the 10-page publication includes: (1) descriptions and photos on mobile and stationary applications up to 600 hp.; (2) advantages of construction; (3) diagrams of oil-to-air coolers for torque converters; (4) hydraulic oil and lube oil with performance charts; and (5) diagrams of oil-to-air coolers including dimension tables, fan specifications, and performance graphs. An analytical description of single-pass and two-pass liquid-cooled shell and tube-torque-converter coolers complete the catalog. Source: **Young Radiator Co., Racine, Wis.**

Hand torch

. . . catalog for gas welding and cutting has just been published. Equipment is covered in detail with general descriptions, features, specifications, and photographs given for each product. Included are specification charts on welding and cutting tips listing

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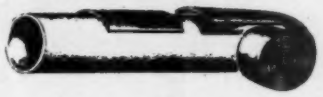

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AMPHIBIOUS SKY YACHT
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There are no screens to clean or filters to replace.
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Investigate this low-cost way of keeping pipeline processes absolutely clean.
SPECIFICATION MANUAL 601 contains data on seven leading types of purifiers, separators, mist extractors, scrubbers. Write.

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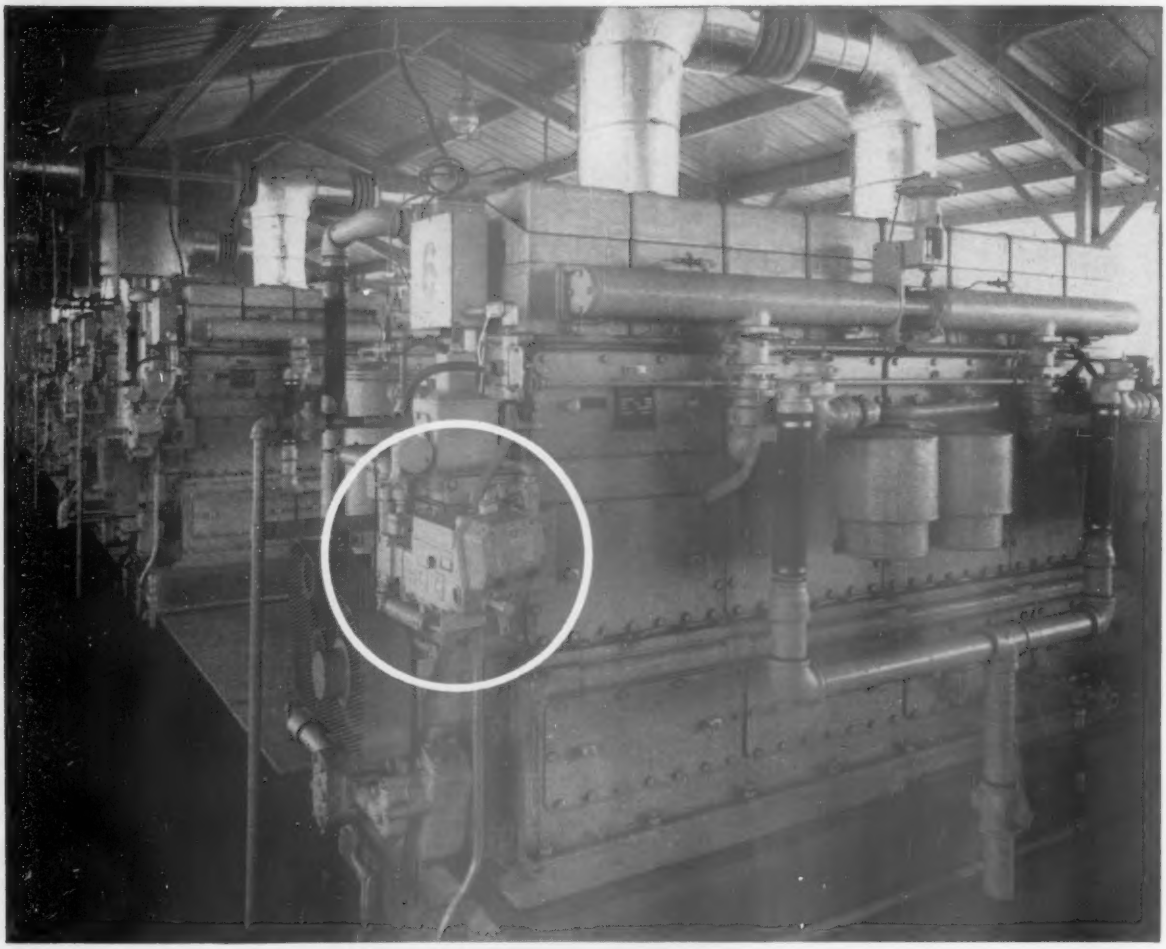
DIVISION OF INTERNATIONAL BASIC ECONOMY CORPORATION



Circle indicates Bendix LC magneto on White Superior engine at Long Beach.

BENDIX LC MAGNETOS HELP POWER GIANT LONG BEACH WATER-FLOODING PLANT

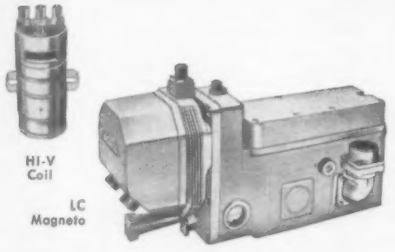
Long Beach, California, operates what may become the world's largest water-flooding plant—drawing water from the Pacific Ocean and pumping it into the Wilmington Tract beneath the city. The additional pressure created will aid in oil recovery and, it is hoped, will reduce land subsidence in the area.

Currently operating at a rate of 120,000 barrels per day, the capacity will be increased and may eventually reach 1,000,000 barrels per day—which would make it the world's largest project of its kind.

The plant is powered by eight White Superior gas engines equipped with Bendix* LC magnetos and HI-V transformer coils. These matched ignition systems, noted for long service life, simplified maintenance at low cost and complete operating reliability, can be used with engines of from six to sixteen cylinders.

If you want to know why major operators are specifying Bendix LC Ignition, write SCINTILLA DIVISION, BENDIX AVIATION CORPORATION, SIDNEY, NEW YORK.

*REG. U.S. PAT. OFF.



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AVIATION CORPORATION

information you might need to make a proper selection for both general-purpose and special gas welding and cutting.

Thirty-six-page Catalog 818 contains information including a general-purpose welding torch with stainless-steel head and fixed-flow valves; two series of hand-cutting torches; four cutting attachments; Bernz-O-Matic kits for utility flame-heating applications; natural-gas heating and brazing ideas; and a wide variety of cutting and washing tips. Source: **Air Reduction Sales Co., 150 East Forty-second Street, New York 17.**

Noble-Metal Themocouple Wire

. . . is the title of a new brochure which provides data on a wide range of noble-metal thermoelements presently being produced. The literature gives temperature-millivolt curves (showing working ranges as well) for various thermocouple materials along with comparisons to certain nonnoble combinations.

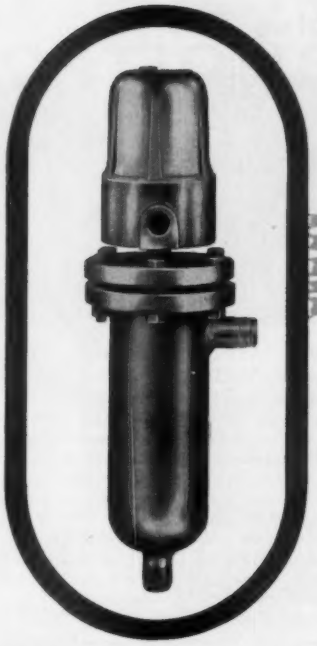
The very close match of characteristics of new Platinel with chromel-alumel thermocouples is shown graphically. In addition, a number of different platinum vs. platinum-rhodium, platinum-rhodium vs. platinum-rhodium, iridium vs. iridium-rhodium, and other combinations are discussed. Some of these systems enable reliable temperature measurements up to 2,100° C. Source: **Engelhard Industries, Inc., 113 Astor Street, Newark, N. J.**

Sludge trap

. . . and filter traps and removes concentrated sulfuric acid sludge, allowing controlled-volume pumps to work efficiently, as described in new Bulletin 459 now obtainable. It explains design features, operation, and includes diagrams. Source: **Milton Roy Co., 1300 East Mermaid Lane, Philadelphia 18.**

Brazing alloys

. . . brochure lists compositions, melting points, and other data on silver solder and other obtainable low-temperature brazing alloys. The 4-page literature piece also contains a chart comparing the alloys to other brands available. Source: **American Brazing Alloys Co., P. O. Box 11, Pelham, N. Y.**



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"I've found through actual on-the-job experience that Cat cutting edges wear twice as long as other makes. We just can't afford to use any other make of edge."

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▶▶▶ Equipment Men Notes

J. E. (Ed) Byers is promoted

. . . to sales manager of the Oilfield Equipment Division of Black, Sivalls & Bryson, Inc., according to Paul Bartley, vice president and division manager. Byers previously served as regional sales manager of the division's Gulf and Pacific region. Prior to that

J. E. Byers

Glenn Bradford

he was district sales manager of the Tulsa oil-field district for 6 years. He joined BS&B 24 years ago.

Bartley further announced that Glenn Bradford has been transferred to Houston as oil-field district sales manager. Charles L. Little becomes oil-field district sales manager at New Orleans replacing Bradford. The

C. L. Little

H. O. Ebeling

Shreveport and Dallas oil-field districts have become consolidated with Harold O. Ebeling, district sales manager at Dallas, named as district manager.

Bradford, who has been district sales manager at New Orleans for the past 6 years, has been with BS&B 11 years. He formerly served as branch manager at Lafayette, La. Little joined the company in 1951 and has been senior sales engineer in New Orleans for 8 years. Ebeling has been Dallas' district sales manager since 1958. Prior to that he was manager of sales engineering.

GATHERED during the recent annual meeting of W. C. Norris, Mfr., division of Dover Corp., are members of the company's sales organization. Forty-three company representatives and officers attended the event during which new and improved products were studied. Present at the 3-day meeting were, seated from left: William L. Butler, president; LeRoy Mitchell, Hamp Brooke, O. L. Scott, S. R. Hill, Bill Black, M. L. Parker, H. F. Nostrand, advertising manager; A. L. Ethriedge, Bob Roberts, J. E. Giles, J. C. Schaff, Kenneth Hance, Gerald Holleyman, G. W. Davidson, Jr., vice president of sales; and D. P. Hagaman, general sales manager. Standing, from left, are: J. A. Getty, Jr., C. L. Snelling, W. J. Whitaker, R. W. Clifford, M. E. McKelvey, A. A. Hardy, Dan Coates, R. L. Preston, W. C. Tolleson, J. G. Russell, D. W. Stewart, K. M. Cook, R. L. Seale, George White, Don Kyle, Paul Covard, Don Smith, Ed Scholl, Bud Burney, Earl Carpenter, Don Durbin, Bill Peterson, Joel Little, Ed Chaney, Dwight Maney, Jim Chambers, and Gordon Shay.

Jack L. Gates becomes

. . . sales and service representative for Nelson Electric Mfg. Co., of Tulsa, for the states of Louisiana and Mississippi. The announcement comes from Nelson's president, N. A. Norberg. Gates has over 22-years experience as application engineer with refining, chemical, pipeline, and utility firms. He has completed 3 years as agency sales manager for the Nelson firm.

Mission appoints Jack Stewart

Jack Stewart

. . . as domestic sales manager, announces T. R. Fullinwider, vice president of domestic sales. Stewart has been with Mission Mfg. Co. for 19 years, joining the engineering department in 1941. He became a city salesman in the sales department in 1951, and in 1955 was promoted to assistant domestic sales manager. In his new post, Stewart succeeds Fullinwider, who recently was named vice president.

Acme Oil Tool Co., Inc. merges

W. D. Warner

. . . with Great Bend Fishing Tool Co., according to officials of both Oklahoma City companies. The new organization, to be known as Acme Tool, Inc., will offer oil-field services, fishing-tool rental and engineering service, directional drilling, and oil-field machine shops. William D. (Bill) Warner, president of Great Bend, is chairman of the board, and F. W. (Bill) McFarland, president of Acme Oil Tool, is president of the new organization.

Other officials are: Harold Sadberry, executive vice president, who is general manager of all fishing-tool

PLANNING SALES MEETINGS to introduce new tools in the West Coast-Alaska areas are these Halliburton Oil Well Cementing Co. men. From left: Roy Perkins, Bakersfield fieldman; Floyd Vaughn, Los Angeles-Norwalk customer contactman; T. O. (Tiny) Roe, customer contactman at Los Angeles; Ed Trapp, sales manager from Halliburton's Duncan, Okla., headquarters; and Allen Heater, Montalvo fieldman. New tools include insert-type floating equipment and the EZ Lok limit clamp that doesn't require welding.

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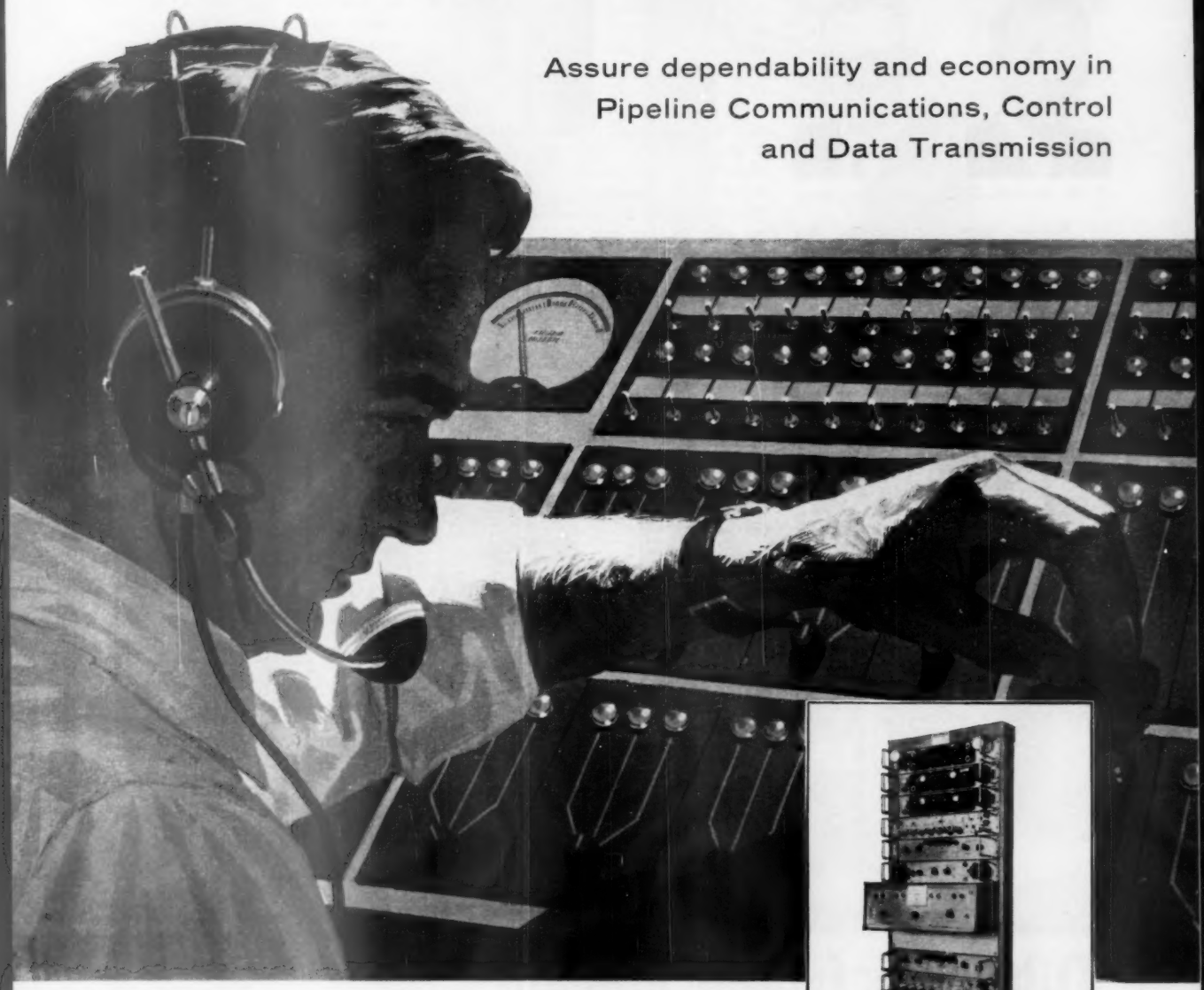

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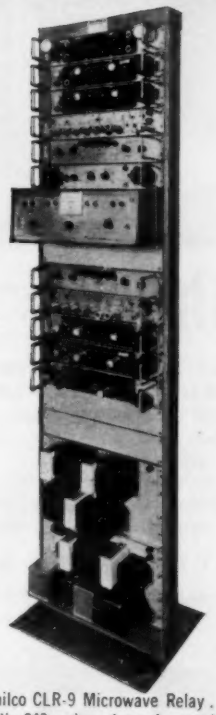


Philco CLR-9 Microwave Relay . . . with 240 voice channel capacity. Available in Common Carrier, Industrial and Government bands.

operations; Wayne Sanderson, manager of Acme Tool, Ltd., Edmonton branch; Rene Crothers, manager of the Rocky Mountain division; and Clonnie Akins, manager of the Southern division.

F. W. McFarland

Harold Sadberry

H. R. Safford, Jr. discusses

. . . customer practices which could be changed to reduce costs among oil companies in a talk recently before the Houston chapter of American Petroleum Institute. Safford, executive vice president of Petroleum Equipment Suppliers Association, mentioned unnecessary deliveries as the first customer abuse. He urged his audience to ask field personnel to order ahead or to wait until a regular order for supplies is placed on routine orders of "staples." Second abuse mentioned was that of oil men asking too much for used equipment on trade-ins.

In conclusion, the PESA official reminded those present that the lowest-priced equipment is often not the cheapest. Safford called the practice of buying on price alone self-destructive.

Baker Oil Tools, Inc. announces

H. L. Hanright

. . . the consolidation of its northern and southern Rocky Mountain districts into one large district under the direction of K. J. (Ken) Kurtz, who will headquarter in Denver. At the same time, Baker promoted R. B. (Cocky) McCannon to Northern California district manager, and H. L. (Hap) Hanright to training and sales-promotion supervisor in Los Angeles.

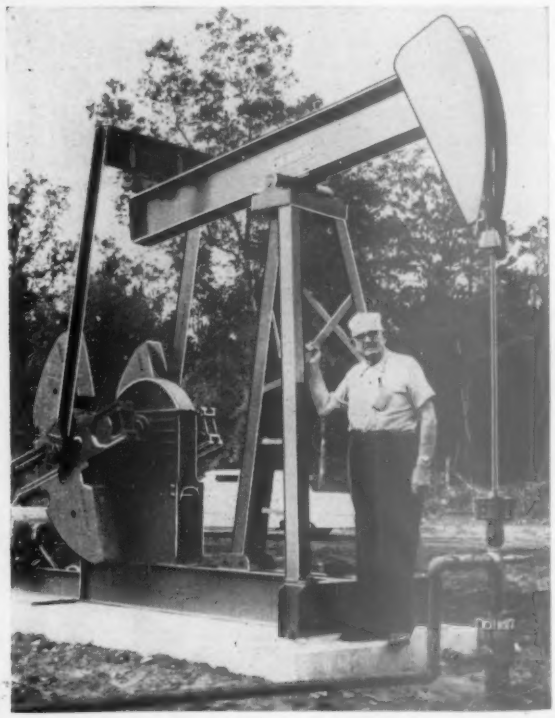
K. J. Kurtz

R. B. McCannon

Kurtz's service with Baker began in 1944 as an oil-field service engineer in Taft, Calif. In 1952 he moved to the Rocky Mountain area as branch manager in Vernal, Utah, and later held the same post in Sterling, Colo. Kurtz served as subdistrict manager in both Sterling and Billings, Mont., and then in 1959 was made northern Rocky Mountain district manager with headquarters in Billings.

McCannon will bring to his new post nearly 30 years' experience with the company. Except for a few months spent in Venezuela in 1949 as export service engineer, McCannon has served various California oil fields as a serviceman, service engineer, and as branch manager in Bakersfield.

Hanright went to work for Baker in 1952 as an oil-field-service engineer at Williston, N. D., and in 1954 became branch manager there. The next year he was made subdistrict manager of the northern Rocky Mountain district, and in 1956 moved to Denver as assistant district manager. Hanright's promotion to southern Rocky Mountain district manager came 3 years ago.



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Every hole enlarging job presents its own special set of conditions. That is why Grant, with more experience in this highly specialized field than any other manufacturer, has engineered specific tools for *your* particular job. For opening rat-holes . . . enlarging hole for the casing string . . . under-reaming before cementing—in any well—Grant's 30 years of specialization have produced the right tool for the job at hand.

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That's J. W. "Frenchy" Seilhant talking. He's Drilling Super for Farr-Bolton Production Company—bosses the company's Cooper rig working in Texas' Bethany Field.

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"Frenchy" says, "That quick change will beat 'em all . . . in fact, TORQMATIC makes the difference between a trouble-free rig and a bad one. Take the shock off the equipment as TORQMATIC does and your rig is bound to run better and last longer."

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THE MODERN DRIVE FOR MODERN EQUIPMENT

TWENTY-THREE DRILL COLLARS are often used to give extra weight in the McComb area. This crew is part of Rimrock Tidelands, Inc., Rig 19, drilling Sun 3 Carroll.

Mississippi town is booming

McCOMB is a little city (15,000 pop.) in the south-central part of Mississippi that is experiencing the state's hottest deep-drilling play.

A recent activity countdown shows over 50 wells completed on 40-acre spacing, 34 rigs drilling, 8 locations being cleared of timber in the pine-wood rolling hills, and 9 drill sites ready to go and listed as "waiting on rig."

Objective is a prolific pay in the lower Tuscaloosa at 10,000 to 11,000-ft. depths. Initial potentials of the wells through small chokes will average 300 bbl. per day in McComb field.

Townspeople say that the new prosperity of a drilling play bordering their city limits is evident only in spiraling prices and scarce housing. Oil operators have not yet begun to draw on the local people to fill operating jobs.

When J. Willis Hughes and Sun Oil Co. drilled the McComb discovery well on its Gillis lease, it also brought along operating personnel from nearby Brookhaven. Other companies have followed pretty much the same pattern in filling jobs.

On the business end of McComb field, with the operators, drillers, and producers, you get the other side of the picture. Everything is moving at a fast pace. The field hasn't been defined closely on any side, and there

MOST OF the equipment in the field is heavy-duty, with jackknife masts capable of going to 15,000 ft. Note the steel mud pits.

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CHAN'NEL.ING 1. To form a channel in; to groove. 2. To convey into or through a channel or channels. 3. Oil Well Drilling. In well cementing, a condition resulting from incomplete removal of fluid, gelled mud and filter cake from behind the casing by the ascending cement slurry.

CHANNELING MEANS . . .
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(2) Mud left behind the casing
(3) Expensive squeezing
(4) A poor completion

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Standard Size, Figs. 400T, 500T

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Standard Size, Figs. 400P, 600P, 700P, 800P

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is much optimism everywhere. Ike Snead, production foreman for Sun Oil Co., pointing to a newly cleared tract of about 5 acres, said: "When you come back next time, we'll have a gas-dehydration and transmission plant over there."

Throughout the field it's the same tempo. A trucker, in replying to the question "How much oil are you hauling out of McComb field?" said: "Yesterday we had 13 trucks working, tomorrow we'll have 15. We put over 10,000 bbl. of oil into the pipeline outlet with the 13 trucks; with two more trucks we hope to make it 15,000 bbl."

A typical rig in the field has been punching hole down to around 11,000 ft. in 19 days or less, using rock bits, 4½-in. drill pipe—and 23 drill collars. "If the hole gets a little off vertical, we back off on some of that bit-weight," one driller said.

The big lease play has simmered down, but not before one enterprising lease broker signed up a number of town-lot owners, and a good portion of the town's cemetery. Apparently the many owners, coowners and heirs of the small plots weren't too much of a problem, but the paper and foot work on such an undertaking would be staggering. Going price on cemetery-lot leases: $27 each. When and if these lots are drilled, either the cemetery or adjacent houses will have to go, there isn't room to spot a rig.

McComb field was placed under state proration order on March 1, with a per well allowable of 150 bbl. per day. A purchasing proration is also in effect. The new state order isn't expected to have much effect on the drilling rate for a time, but it may, as one driller expressed it, "quiet things down to a dull roar."

The allowable will slow the drop in reservoir pressure, brought about by the rapid withdrawal of crude, and which many operators viewed with some alarm.

Quite a few contractors are active in McComb field. The larger firms—in number of rigs running—are: Dorris Ballew, Inc., Natchez, Miss.; Reading & Bates, Inc., Tulsa; Marshall R. Young, Brookhaven, Miss. Other companies with rigs working include: Barnwell Drilling Co., Shreveport; Sunnyland Contracting Co., Rayne, La.; Fortenbery Drilling Co., Natchez, Miss.; Larco Drilling Co., Jackson, Miss.; Rowan Drilling Co., Fort Worth; Dixilyn Drilling Co., Odessa, Tex.; Rimrock Tidelands, Inc., New Orleans; Empire Drilling Co., Dallas; Milton Crow, Inc., Shreveport; Frank M. Woods Associates, Inc., Wichita Falls.

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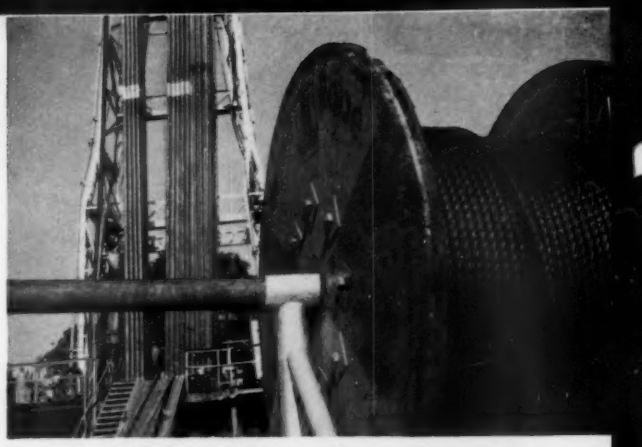

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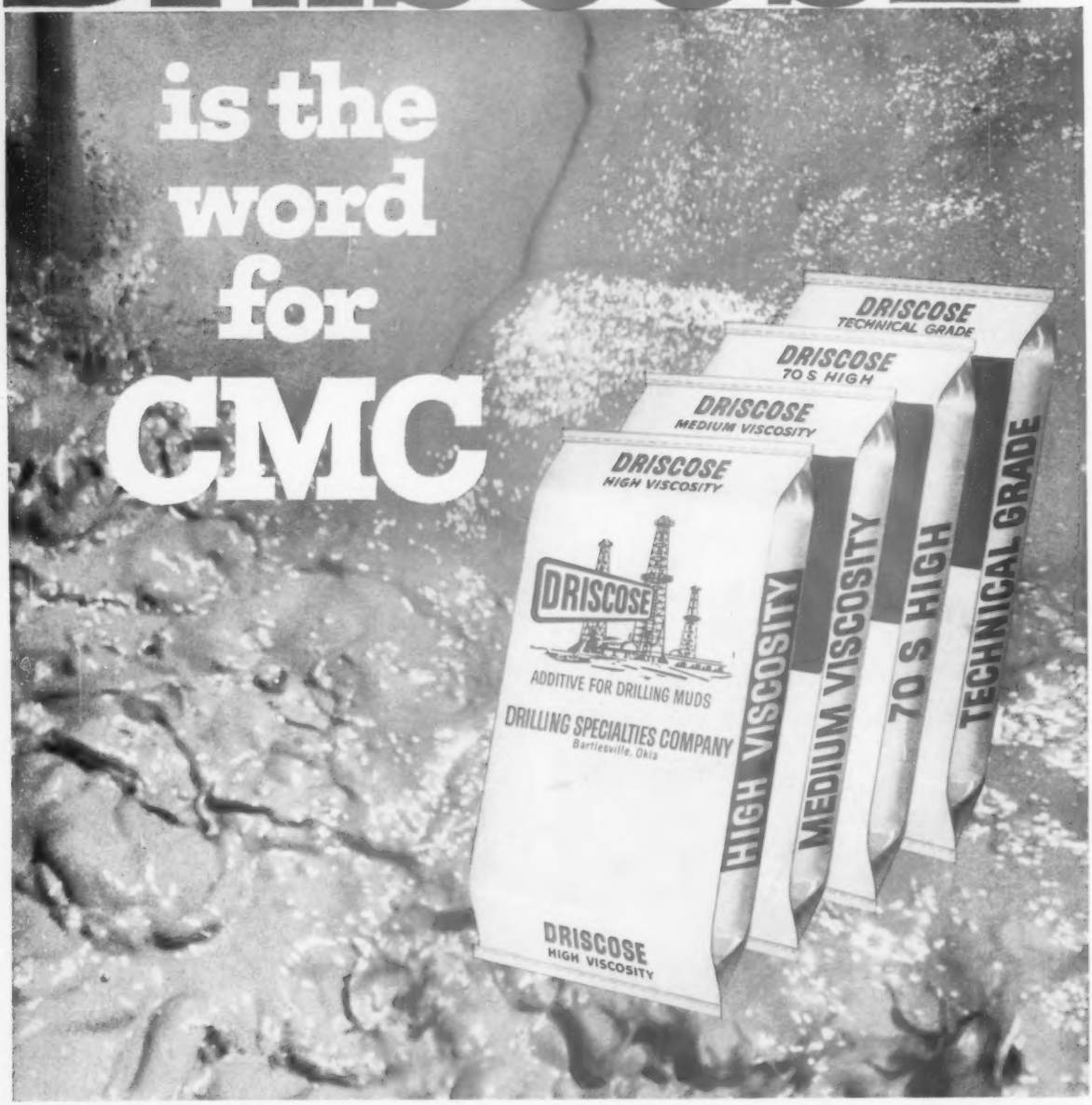

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DRILLING SPECIALTIES COMPANY
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FIRST OIL DISCOVERY in Missouri since 1953 occurred at the end of 1959 in Holt County, in the Forest City basin. The Currie wildcat, 12 miles southwest of Tarkio, only other oil field in this part of Missouri, has led to renewed lease activity in the region.

Missouri gets new field

BY FRANK J. GARDNER

A RARE DISCOVERY of oil in Missouri may now be fully chronicled. Details of a recent exploration program in the northwest corner of the state have recently been released, and while they disclose nothing in the way of "big oil," they do point up the possibilities that await the independent operator in the Forest City basin.

This large, sparsely explored basin, underlying 15,000 sq. miles in Iowa, Missouri, Kansas, and Nebraska, offers prospects down to 4,000 ft. The wildcat drilling density is about 1 to 250 sq. miles, and exploration campaigns at reasonable cost should attract more drilling in the years ahead.

A good discovery . . . One such campaign resulted in the recent discovery on the Atchison-Holt county line in Missouri. It was launched by William Gruenerwald, a Chicago geologist-wildcatter who has been quite active in the Forest City country during recent years. His better successes have been scored on the Kansas side, but now he has added Missouri to his collection by completing the 1 Currie (Section 21-63n-40w) for 125 bbl. per day of 29.9° oil from the Viola-Ordovician at 2,967-72 ft. This is the first Viola field in this part of the state.

The Currie lease was part of a farmout deal negotiated by Gruenerwald and Humble Oil & Refining Co., Carter Division. A core-drill survey revealed a small anomaly about 2 miles northeast of Corning, Mo. A dry hole, the Senick 1 Weedin (Section 33-64n-40w), had been drilled in southern Atchison County in 1958; it stopped at 3,715 ft. in Precambrian.

Log tops, Currie wildcat, Holt County, Missouri

Elevation	973 ft., KB
Heebner	489 ft.
Lansing	674 ft.
Base Kansas City	998 ft.
Cherokee	1,152 ft.
Mississippian	1,820 ft.
Kinderhook	2,050 ft.
Devonian	2,195 ft.
Hunton	2,300 ft.
Maquoketa	2,855 ft.
Viola	2,960 ft.
Granite wash	3,124 ft.

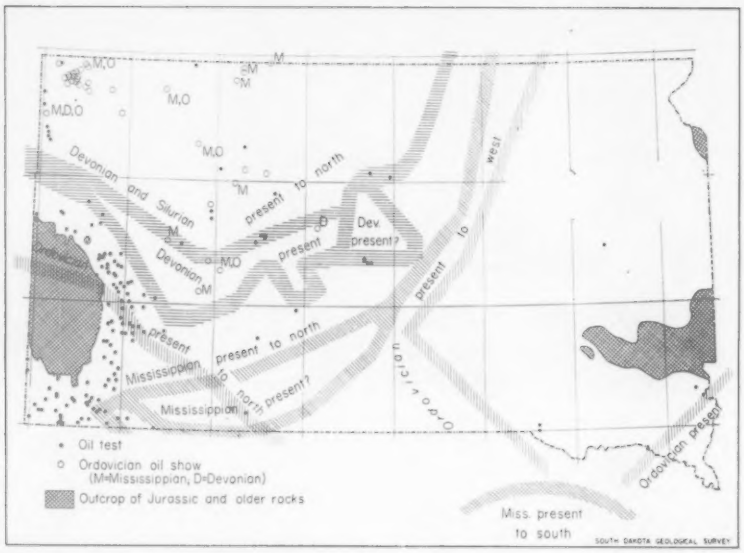
Believing the Weedin failure to lie north of the prospective pool, Gruenerwald moved south into Holt County and staked the Currie wildcat. After drilling to total depth 3,204 ft., a drill-stem test opposite the Viola section at 2,965-80 ft. recovered 250 ft. of free oil and no water. On first tests in late 1959, the discovery yielded only ⅓ bbl. per hour natural. After perforating with the Dowell Abrasijet at 2,967, 2,969, and 2,972 ft., the operator applied 2,000 gal. of acid and completed the well on pump for 124.96 bbl. per day, no water.

Following this success, Gruenerwald moved 1 mile southeast of the discovery and drilled his 1 McQueen in Section 23-63n-40w; this one, however, was doomed to failure, and was recently abandoned at 3,590 ft.

Now, Gruenerwald is moving in to sink his third test on the Currie prospect. This will be the 1 Gaffney, in Section 22-63n-40w. This new location lies ¾ mile southeast of the discovery and ½ mile west of the McQueen failure.

May lead to others . . . One side effect of the Holt County find has been a rekindling of interest in another old Missouri field at Tarkio, 12 miles northeast of the Currie well. Here, production from the Pennsylvanian-Bartlesville sand was found in 1943, and a small oil pool was developed at the 1,500-ft. level. Now, Gruenerwald has taken the rights below 1,700 ft. and will seek deeper production in the near-depleted Tarkio area.

Other signs point to accelerated interest and drilling throughout northern Missouri. The lease campaign has been quite active. The accidental discovery of 1,100-ft. oil in the Kimmswick-Ordovician near St. Louis in 1953 is just another stimulus to the belief that surface mapping and core-drill work can pay off commercially, if not handsomely, in the "Show Me" state.



LESS THAN 16% of all wells in South Dakota have reached the Precambrian. Only 58% of the total number of tests reached the Pennsylvanian. Fig. 1.

Two geologists suggest:

Dig deep for South Dakota pays

- Only one-sixth of all South Dakota tests have reached the Precambrian.
- Future exploration will search for the many facies and structural traps in the Williston basin area of South Dakota, where increased activity is expected in 1960.
- The oil possibilities of the Cretaceous, Jurassic, and Permo-Pennsylvanian sands in the western half of the state merit further systematic investigation.
- The Kennedy basin area along the Nebraska border will probably be tested by wildcatters who are attempting to corroborate Minnelusa shows nearby in Nebraska.

BY ALLEN F. AGNEW
State Geologist, S. D. Geological Survey, Vermillion
and
JOHN PAUL GRIES
Professor, Geological Engineering, S. D. School of Mines & Technology, Rapid City

OF THE approximately 375 oil and gas tests drilled in South Dakota, only 58% reached the Pennsylvanian. Less than 16% of the total penetrated all of the formations and reached the Precambrian.

Thirty-five per cent of all holes reported shows of oil or gas; however, in Williston basin area the percentage of shows has been twice as great as elsewhere in the state.

Buffalo field in the southwestern part of Williston basin has had 18 holes completed as producers in the Ordovician Red River dolomite at a depth of about 8,500 ft. Daily production is now about 1,000 bbl. oil, with a small amount of gas. The only other oil production in the state is from the Minnelusa Leo sands at a depth of 1,390 ft. in a well at the southwestern edge of the Black Hills.

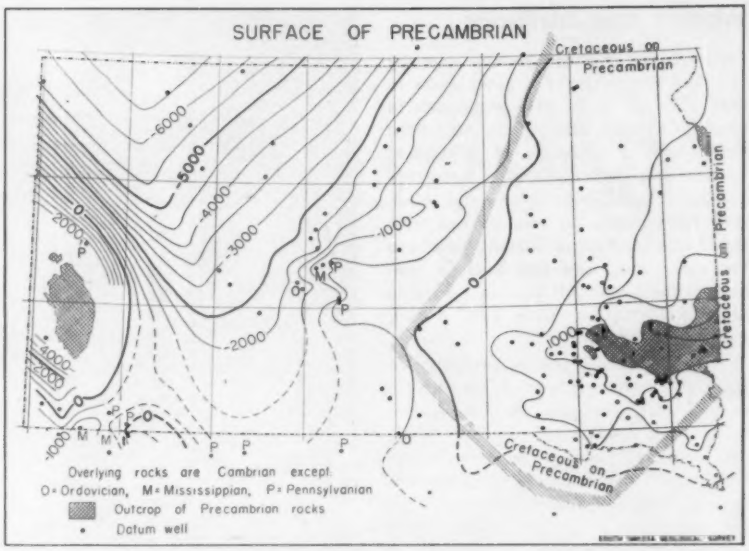
In 60% of the state, Precambrian rocks are overlain by Mississippian or older Paleozoic rocks (Fig. 1). Considering that the Precambrian lies at depths no greater than 5,000 ft. in two-thirds of this area, the percentage of Precambrian tests is surprisingly small.

The oldest potentially productive zone, the Ordovician-Winnipeg sandstone, was prospected by only a few more holes. The number that tested the Ordovician-Red River dolomite's upper porous zone (including those in Buffalo field) is still less than 40% of the total holes drilled (Fig. 4).

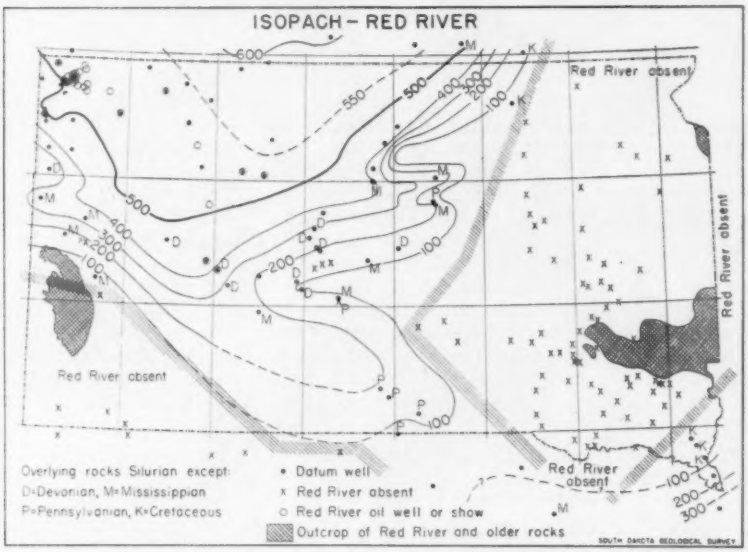
However, any possibilities in the lower part of the Red River were overlooked where holes are shown on the Red River structure map (Fig. 4)

This paper was presented before the Rocky Mountain Section, AAPG, in Billings, Mont.

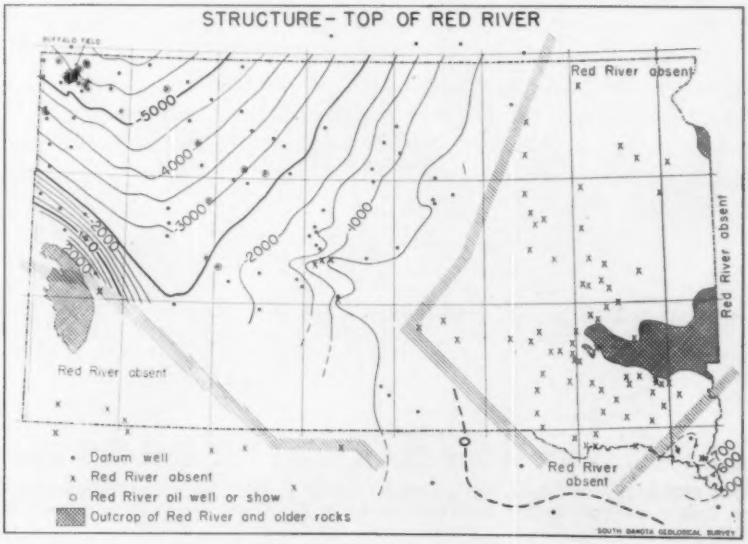
STRUCTURE MAP is on the top of the Precambrian. Fig. 2.



THICKNESS of the Red River is greatest to the north. Fig. 3.



STRUCTURE on the top of Ordovician-Red River dips northwest. Fig. 4.


STRUCTURE - TOP OF RED RIVER
Red River absent
Red River absent
Red River absent
Red River absent
Datum well
Red River absent
Red River oil well or show
Outcrop of Red River and older rocks

About the authors . . .

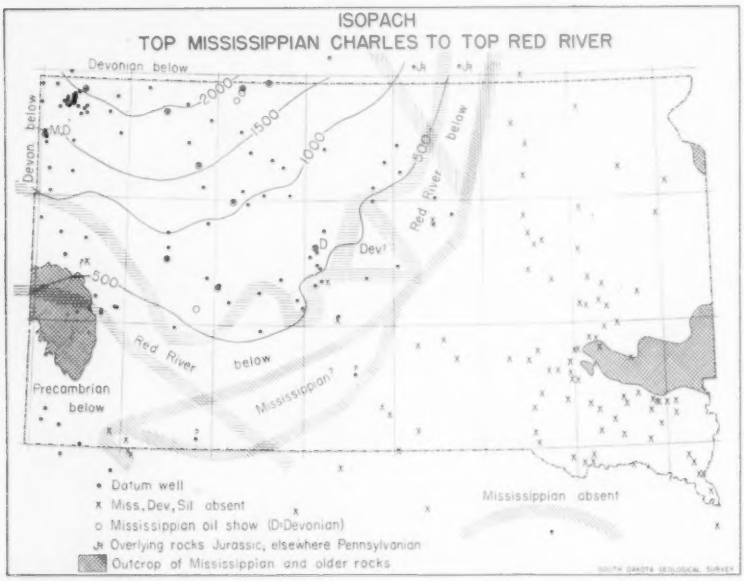
TWO DEANS of South Dakota geology tell why their state is a good place to look for oil. Both are professors in geology at state schools. Dr. John Paul Gries, left, is professor of geological engineering and director of graduate studies at South Dakota School of Mines and Technology. He has worked with the Illinois Geological Survey, Magnolia Petroleum Co., and has been a consultant for Carter Oil Co., now Humble Oil & Refining Co., since 1947 during the summers.

Dr. Allen F. Agnew is professor of geology at University of South Dakota and is state geologist. He has worked for Illinois Geological Survey, USGS, and was professor of geology at University of Alabama before his present tenure at South Dakota. He received his education at University of Illinois and Stanford University.

but not on the Red River isopach map (Fig. 3). And, as if to show their disdain for any pre-Pennsylvanian possibilities, only 58% of the oil tests penetrated deep enough to touch the Mississippian carbonate rocks, as shown on the Mississippian structure map (Fig. 6). Again, a significant number of these holes did not test all Mississippian potentialities, let alone the Devonian, Silurian, or Ordovician. Compare with the isopach map (Fig. 5).

Holes that did not reach Pennsylvanian rocks are clustered mainly around the Black Hills uplift (Fig. 1). Sixty per cent of the oil tests around the Black Hills did not reach the Pennsylvanian, an astoundingly large number. High-gravity paraffin-base oil production from Newcastle sandstone in the Greater Clareton area of Powder River basin to the west, and in the "D" and "J" sands of Denver basin to the south, caused a surge in drilling to test Newcastle, Fall River, and Lakota sandstones in South Dakota around the Black Hills, but results to date have been discouraging.

To cap it all, many of the holes in the Black Hills area did not test even all of the Cretaceous possibilities, not to mention the Jurassic sandstones below. In fact, either by mistake or by design, three recent legitimate oil tests in the Black Hills area actually bottomed above the Newcastle sandstone, which they were seeking.



THIS ISOPACH MAP shows the presence of a fairly thick section of Mississippian to Ordovician beds in the northwest sector of the state. The drilling density is relatively low. Fig. 5.

Shows of oil. Oil shows have been relatively abundant in South Dakota tests, 35% of the holes drilled have reported oil stain or shows, recovered oil on drill-stem tests, or been productive. This percentage ranges from 54% for Williston basin to 22% in the Black Hills fringe. In Williston basin, most shows were reported in the Ordovician-Red River dolomite, understandably, because Buffalo field produces from that formation; however, one-third as many Mississippian shows were found.

In the Black Hills fringe, Pennsylvanian shows were found in approximately 40% of the holes. Other areas were less favored except for the southeastern corner of the state, where two of seven tests reported shows, mainly in the Ordovician-St. Peter sandstone.

Present

Presently Buffalo field (Fig. 4) has 18 producing wells, pumping from a zone 35-55 ft. below the top of the Ordovician-Red River dolomite. The pay zone, which ranges from 12 to 17-ft. thick, produces 30°-34°-gravity oil, with a gas-oil ratio that ranges up to 130. Ratio of oil to water produced ranges from 10 to 1 in the best

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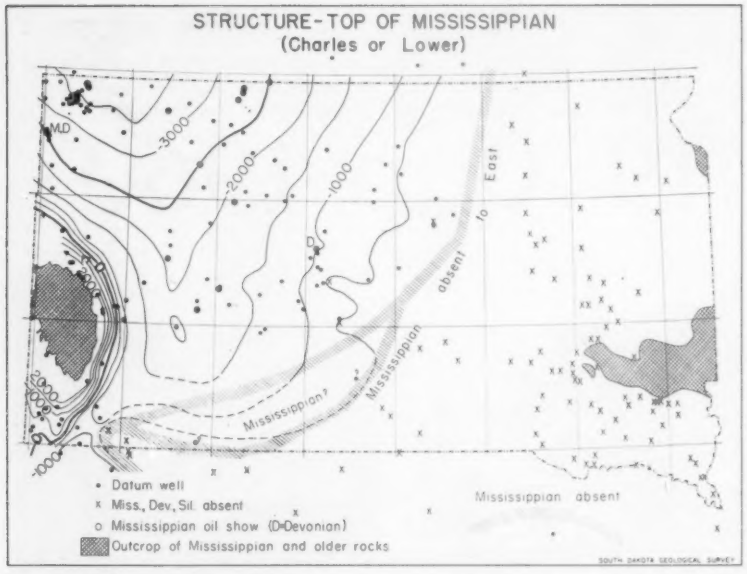

BARELY MORE THAN HALF (58%) of all tests in the state penetrated the entire Mississippian section. This leaves a big question mark concerning the potentials of the underlying Devonian, Silurian, and Ordovician pays. Fig. 6.

wells, to 1 to 7 in the poorest. The 18 producing wells are on 160-acre spacing in 11 sections. The oil is produced from 8,450 to 8,550-ft. deep, and the wells produce 20 to 200 bbl. of oil daily, averaging 50 bbl. The oil lies along the eastern limb of a southern extension of the Cedar Creek anticline, and the structural slope is interrupted by crossfolds which may partly control the presence of the oil. A pattern of oil occurrence has not yet been established, and hydrodynamic problems remain to be solved.

Barker Dome field (Fig. 7) has one well on pump, which produces from a thin Leo sand zone about 600 ft. below the top of the Minnelusa formation. The pay zone is 1½-ft. thick, and yields a good quality, green, 30°-gravity oil. Sixteen tests have been drilled, mostly on 10-acre spacing in an area of about 1 sq. mile. Many had oil and gas shows, and several produced small quantities of oil initially, some as long ago as 1930. The oil is produced from 1,390 ft., and the well is said to pump at the rate of 40 to 50 bbl. per day, with very little water. High-nitrogen gas is evident in an offset well, which is now shut in. The oil occurs in a lensing sand on a small dome that is mappable at the surface; however, accurate subsurface records are not available for many of the oil tests, so that the subsurface picture is not clear.

Future

The larger structural features of South Dakota are the Black Hills uplift in the western part of the state, Williston basin, and the Sioux Ridge in the eastern part (Fig. 2). Less well known are the relationships of these features to structures along the South Dakota-Nebraska border, which are, from west to east, Denver basin, the Chadron dome or Cambridge arch, Kennedy basin, and the so-called Forest City basin extension in the extreme southeastern corner.

Denver basin touches the extreme southwestern corner of the state. Its smooth contours are interrupted by two southward-plunging anticlinal fingers from the Black Hills; both are evident on the Mississippian structure map (Fig. 6). The western anticline is gentle, but the eastern is asymmetric with an abrupt west limb. Small terraces and noses are common.

Chadron dome, which is at the northern end of the large Cambridge arch of Nebraska and Kansas, appears to be abruptly terminated just inside South Dakota. It apparently is offset to the west, perhaps by a basement fault, so that it joins the southern edge of a third southward-projecting anticlinal finger from the Black Hills. Although Precambrian and Mississippian control is too sparse to reflect it adequately, the Black Hills finger is a major mappable feature in the Lower Cretaceous outcrops.

Kennedy basin, a Precambrian structure mapped by the Nebraska Geological Survey, is apparently reflected as a southern extension of the Williston basin in the Precambrian map (Fig. 2), although it is admitted that the control in South Dakota is not as dense as would be desired. This basin apparently did not influence greatly the deposition of the Red River, as is shown by the Red River isopach map (Fig. 3).

Again, however, your attention is directed toward the somewhat unconventional contouring of the Red River thickness. Although it could be argued that the large area of no control east of the word "absent" on the Red River isopach map would

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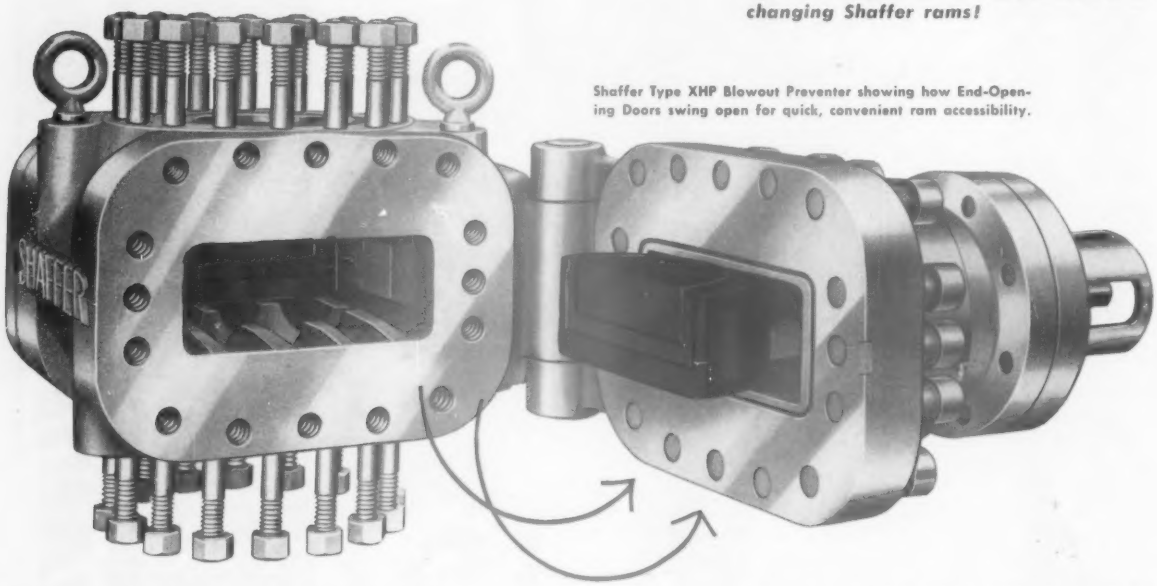

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permit a more conservative interpretation of the thickness, the contours shown here may stimulate a reevaluation of the Paleozoic of South Central South Dakota.

A structurally lower area, present in the extreme southeastern tip of the state, has been related by some geologists to Forest City basin, 150 miles farther south. The Precambrian map of the Nebraska Geological Survey shows an east-west basin near Omaha, just north of the Thurman-Wilson faulted anticline that extends eastward into Iowa; this structure appears to have interrupted the northward extension of the Forest City basin.

Sioux Ridge is not only a Precambrian ridge of Sioux quartzite which affected later sedimentation, but also appears to have been active in pre-Pennsylvanian time, as is shown by the narrowing of the Red River isopach lines. This may be the transcontinental arch of Levorsen and others, from Minnesota southwestward to Colorado. The steep western end of the Sioux quartzite in Central South Dakota is in an area of later crustal instability, as is shown by abrupt differences in age of the overlying rocks; in addition, the South Dakota Geological Survey's magnetometer maps of Petsch, and seismic maps show an abrupt change in trend of anomalies in this area, from westward to north-northwestward.

Williston basin is well known structurally, except that smaller, economically important folds are not yet completely defined. The Cedar Creek anticline which enters the extreme northwestern corner of the state from Montana, and parallel folds are near the southwestern margin of the basin (Fig. 4). The southward extension of the highly poductive Nesson anticline of North Dakota is known only from geophysical evidence and a relatively few drill holes in North Dakota. Similar folds on the southern fringe of the basin could provide other structural traps. In this regard, note the minor kinks in the structure contours on the Mississippian (Fig. 6) in the southern part of the basin.

At the northern edge of the Black Hills, where Williston basin and Powder River basin approach each other, minor folds projecting north-northwestward constitute excellent structural traps.

South Dakota is well endowed with favorable stratigraphic conditions for the accumulation and entrapment of petroleum. The isopach map of the Ordovician-Red River dolomite (Fig. 3) shows a rapid thinning at the margins of Williston basin. Apparently

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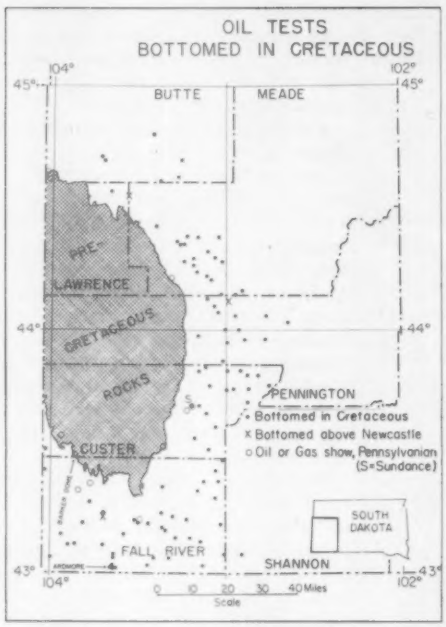

THIS PORTION of the state has been "shallow tested." Most ventures bottomed in Cretaceous. A general disdain appears prevalent concerning Pennsylvanian possibilities around the Black Hills uplift—only 40% of the tests there reached the Pennsylvanian. Fig. 7.

this thinning is accounted for by the truncation of the upper and middle parts of the unit, rather than by a uniform thinning of all parts of the Red River. This map also shows areas of significant local truncation, which appear to be related to structural crosstrends, as in the area just southwest of Buffalo field. Areas along the borders of Williston basin where Devonian, Mississippian, or Pennsylvanian rocks overlie the Red River are also potential unconformity traps. Note the distribution of shows in the Red River dolomite.

Rocks mapped here as Silurian are present below the Devonian in Williston basin (Fig. 1). These include the Ordovician-Stony Mountain and the Silurian-Interlake formations. However, no shows have been reported, despite Silurian production farther northwest along the Cedar Creek anticline in Montana, where porosity is related to a pre-Late Devonian unconformity. Silurian oil shows and production in a few fields in the deeper part of Williston basin apparently may not have a parallel in South Dakota, as these productive zones are lost by truncation before they reach South Dakota.

Devonian shows have been reported from only two tests in South Dakota (pl. 4). Nevertheless, although some zones that are productive in North Dakota are absent from South Dakota, the Souris River and Birdbear formations present truncation possibilities here. The irregular southeastward extension of the Devonian as shown on the map reflects the change in facies to a more clastic rock in that direction.

The Mississippian Madison carbo-

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nate section appears to present many stratigraphic possibilities for oil in South Dakota. The isopach contours (Fig. 5) reflect the truncation of the upper, Charles facies, and then the Mission Canyon, below. The Lodgepole facies is apparently the only part of the Williston basin Mississippian carbonate section that reaches the Black Hills. Widely scattered shows have been reported in South Dakota from both the Charles and Mission Canyon, and possibly from the Lodgepole.

Beginning with the Pennsylvanian, the depositional pattern was significantly different. The Pennsylvanian-Permian rocks contain a more heterogeneous assemblage of lithologies than earlier Paleozoic systems. Lensing quartz sands, anhydrite, and dolomite present many facies trap possibilities. More than 40% of the holes drilled around the Black Hills recorded Pennsylvanian shows of oil or gas. A reported Minnelusa oil show in Nebraska on the northeastern limb of the Cambridge arch is significant.

At least three zones within the Minnelusa formation are of current interest.

South of the Black Hills, oil shows are consistently reported from the Leo sand sequence in the lower half of the Minnelusa, and as mentioned before, one well on the Barker dome produces oil from this sequence.

On the western and northwestern flanks of the Black Hills, good oil shows are commonly reported from the upper Minnelusa-Converse sands. This zone of sands has normally been considered to be well flushed by artesian water. Several recent discoveries of upper Minnelusa oil in Wyoming along the northwestern flank of the Powder River basin, most notably at Donkey Creek, indicate that under conditions of rapid stratigraphic changes, with or without accompanying structures, oil may be entrapped in the Minnelusa.

North of the Black Hills, oil-saturated sands are known in the top of the Minnelusa both in Wyoming and in South Dakota (Fig. 1). Where tested on structures close to the outcrop, only water has been recovered in South Dakota, and the oil appears to be oxidized.

The Minnelusa on the northeastern flank of the Hills exhibits rapid lateral changes in its upper beds. Part of these are true facies changes, and some are related to the unconformity at the top of the formation. Flushing seems to be limited to a very narrow belt near the outcrop. The chances of finding stratigraphic traps appear good, particularly on some of the anticlinal noses north of the Black Hills but farther from the outcrop than most of the existing tests.

A test on the eastern flank of the Black Hills showed Jurassic Sundance oil (Fig. 7), and stain was reported in a test in the central part of the state. The Sundance sandstones possess oil possibilities also where they rest directly on Mississippian carbonate rocks along the north-central border of the state (Fig. 5).

Cretaceous sandstones, which are so productive in the Powder River basin on the western side of the Black Hills, have recorded shows in more than 20% of the tests in the Black Hills area of South Dakota, especially at the southern end and along the southeastern side. Potential oil-bearing zones in South Dakota include the Lakota and Fall River sandstones, and the overlying Newcastle sandstone. Although regarded as a flushed formation, the Fall River sandstone has been productive of oil at several fields just across the border in Crook County, Wyoming, notably Donkey Creek, Miller Creek, and Coyote Creek.

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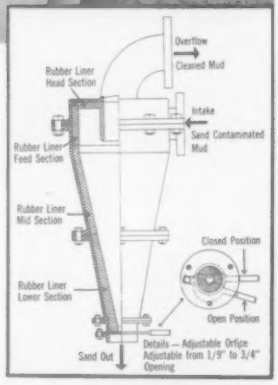

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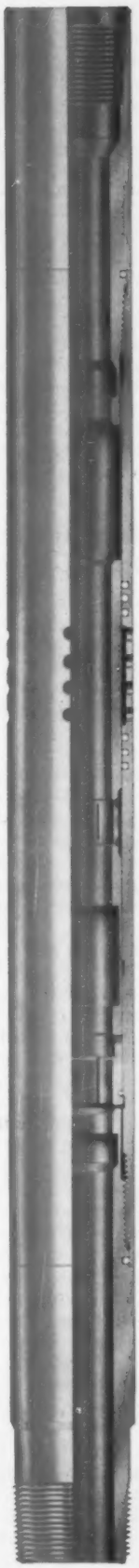

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are confined to a very narrow belt close to the outcrop. Southeast of the Black Hills, where the Fall River has been more frequently tested, the sand is exceptionally well developed, and its oil prospects are less promising. On the northeastern flank, however, the sand is much thinner, its development is more irregular, and appreciable variations in quantity and chemical quality of the water are evident.

Although no authenticated shows from the Fall River have been reported from the few water wells in this area, certainly oil tests directed toward the overlying Newcastle sandstone should not be stopped until the Fall River-Lakota sandstones have been penetrated.

Recent information regarding the lenticular nature of the Newcastle sandstones on the western side of the Black Hills, where oil production has been obtained, should be useful in re-evaluating the Newcastle possibilities on the eastern side of the Black Hills. Newcastle gas in noncommercial quantities was found in some of the oil tests at Ardmore on the Chilson anticline south of the Black Hills (Fig. 1).

The dry gas associated with the artesian water from the Dakota sandstones in the central part of the state is not known to be associated with oil.

The Upper Cretaceous-Eagle sandstone has produced gas commercially along the southern end of the Cedar Creek anticline in Montana and North Dakota. Thin tongues of this sandstone in Harding County, and the possibly equivalent Groat sandstone closer to the Black Hills, may be considered as potential sources of gas.

In summary, South Dakota's startigraphic and structural trap possibilities are many and, as can be seen, are relatively untested. This, coupled with the relatively low cost of exploration in South Dakota, especially as compared with the rest of Williston basin, points toward a future of active exploration and discovery in the state.

Geology students take mock journey

University of Texas beginning geology students will take a mock voyage to the earth's center in one of 20 new videotapes prepared by the geology department for showing over the university's closed-circuit television facalities.

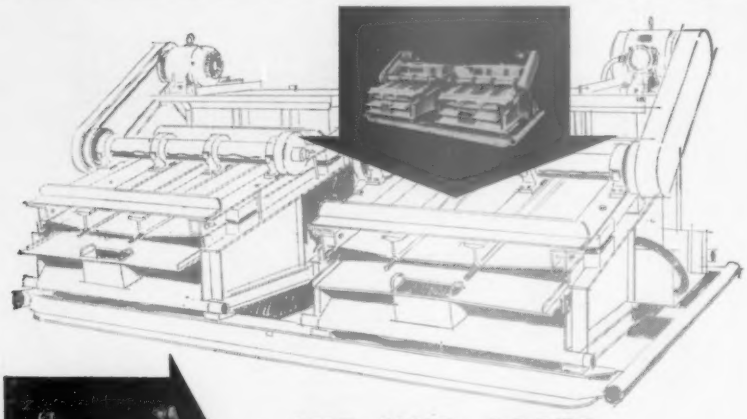
The department this semester is telecasting the 30-minute videotapes for the first time on a regularly scheduled basis to some 450 students.

Dr. William R. Muehlberger, geology associate professor, is "starred" in the television series produced as a supplement to subject matter in regular lectures.

Kinescopes to be made of the videotapes will be available to other colleges and special groups. Already 13 colleges have indicated interest in using the series, Dr. Muehlberger said. Requests came from the universities of Michigan, Arizona, and Houston, and from 10 liberal-arts schools.

Students will see the climaxing tape on "Structure of the Earth" May 17-18. Dr. Muehlberger said students will gain a clearer idea of the earth's interior through diagrams and actual specimens of minerals and elements taken from the earth's outer layers. The tape shows how the earth is built up of a series of overlying shells, something like the stucture of an onion. It describes each shell, from the outer layer of sedimentary and granitic rocks to the inner core of molten iron and nickel, some 2,150 miles from the earth's outer crust.

Dr. Muehlberger presents that tape, and 12 others covering weathering and origin of soil, structure of minerals, ground water, faults and folds, reefs, sand dunes, river characteristics, glaciers, and downslope movements—landslides and mudflows.



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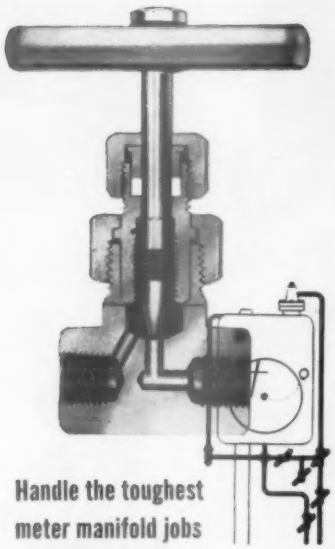

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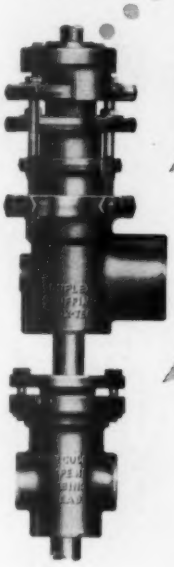
HERCULES is First to provide a complete line of equipment for this new Oil Production Technique.

The use of 2½" tubing for casing and 1¼" or 1½" tubing as the oil string has made it necessary to develop new equipment specifically for this purpose. In response to the requests of production men, Hercules now provides tested and proven production equipment for Slim Hole Drilling. The well-known Hercules "Tee-Type" Duplex Stuffing Box and the new 2½" Hercules Type "HF" Tubing Head are incorporated in this typical Slim Hole well hook-up. Hercules "Tee-Type" Duplex Stuffing Box is now available in 1¼" and 1½" tubing sizes (plain or EUE) with the same packing and parts used in all Hercules Duplex Stuffing Boxes.



HERCULES "TEE TYPE" DUPLEX STUFFING BOX A combination Tee and Stuffing Box with female thread to screw directly onto the 1¼" or 1½" tubing, eliminating one-threaded connection and resulting in a considerably shorter hook-up. 3000 PSI test. Approximate height 15". Weight 33#. Price $31.00.

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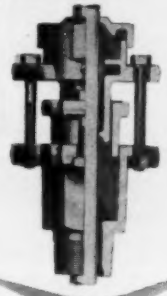

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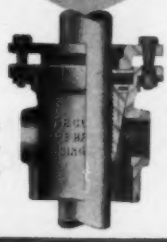

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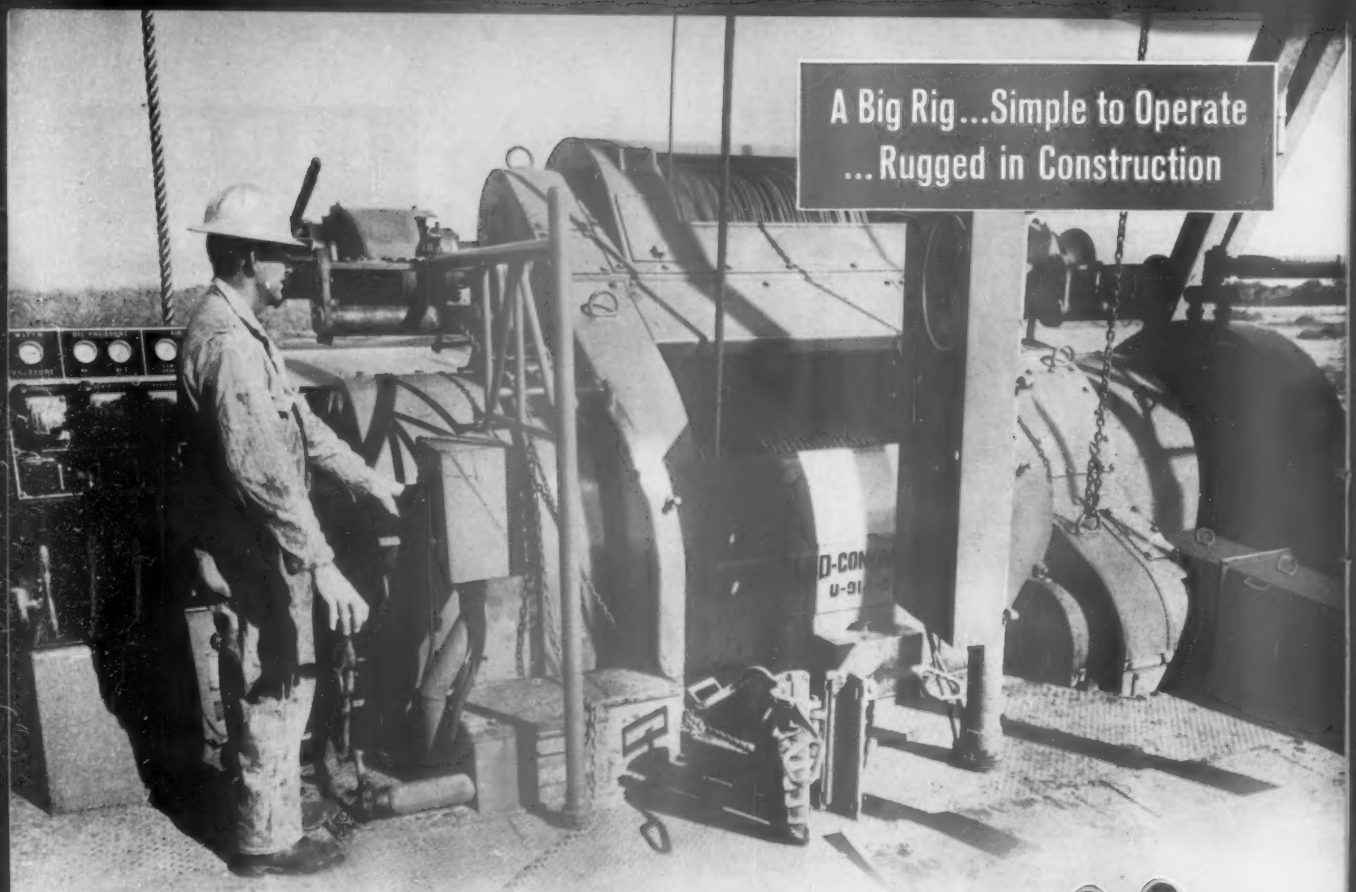

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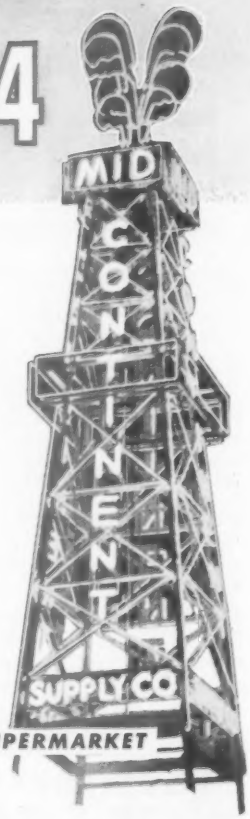

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Drilling plans announced for Alaska's Bethel basin

A 5-year development contract with Shell Oil Co. for exploration and development of 450,000 acres in Bethel basin, Alaska, was approved by the Department of Interior. Shell reportedly will send geophysical parties into the basin this summer. Area covered by the contract is 90 miles southwest of Bethel and borders the northern coast of Kuskokwim Bay. Shell is required to drill at least three wildcats during the contract period, spending a minimum of $950,000.

Second core test will drill in Bethel basin

Another core test will be drilled on Pan American Petroleum Corp.'s Napatuk development in Alaska's Bethel basin. Drilling will begin in March. The first test went to 1,500 ft. Plans call for a second test to go to 2,000 ft. It will be about 20 miles west of Johnson River.

Other Alaska news. BP Exploration Co. will send a geological field party into its 50,000-acre lease in the Umiat region this summer, possibly moving the party to the Yukon-Koyukuk area later. The party will include four geologists, three assistants, one draftsman, two helicopter pilots, a cook, and one helicopter.

- The 1 Nulato Unit of Benedum and Associates is drilling below 6,000 ft. in the Koyukuk basin. It reportedly found good oil shows.
- A 12,000-ft. wildcat should be drilled in the Cook Inlet basin or the Copper River or Alaska Peninsula-Bristol Bay area this year. Polaris Exploration Co.-Teikoku Oil Co. agreement calls for such a well in 1960. Rig will be furnished by Teikoku, but will be manned by Americans. Reports are that it will be a Japanese-made rig, built under American patent franchise.

Canadian drilling reaches high pitch

THE MOST extensive drilling program for oil and gas wells in the history of British Columbia now is reaching a winter climax, with heavy rigs being brought in across the frozen muskeg of the north country.

For every two wells being drilled one is proving productive.

This is the latest picture of B. C.'s multimillion-dollar petroleum industry, an industry only 8 years old, yet with proven reserves of 60,000,000 barrels of oil and 3 trillion cubic feet of raw gas.

As of Feb. 19, a total of 538 wells had been drilled in the province, mines department figures show. Of this, 198 are capable of gas production and 68 are capable of oil production. About 40 rigs are at work and applications are on file for drilling in 14 more locations.

The fees payable to the government from the scores of companies involved in the search have meant about $40,000,000 to the provincial treasury since the first oil well blew in near Fort St. John in 1952.

Mines Minister Kenneth Kiernan recently told the legislature:

"Despite the fact we are already producing approximately one and one-half times the energy of our total hydro production, we must bear in mind that the exploration and development of the Peace River country has merely commenced."

In the Peace River country this winter, he said, "we are experiencing the most extensive drilling program in the history of the province."

The area of greatest interest now centers east of Fort Nelson — itself only 80 miles south of the Northwest

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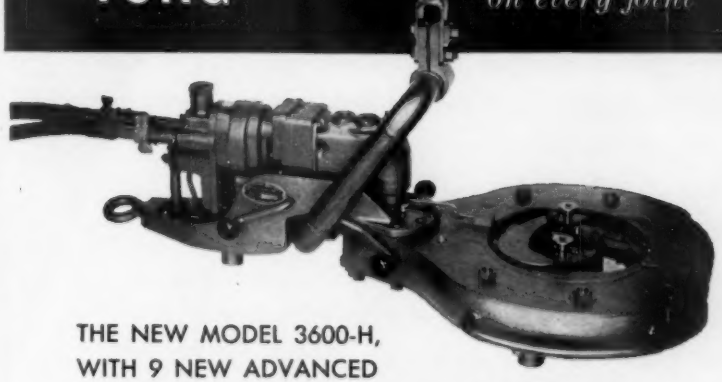

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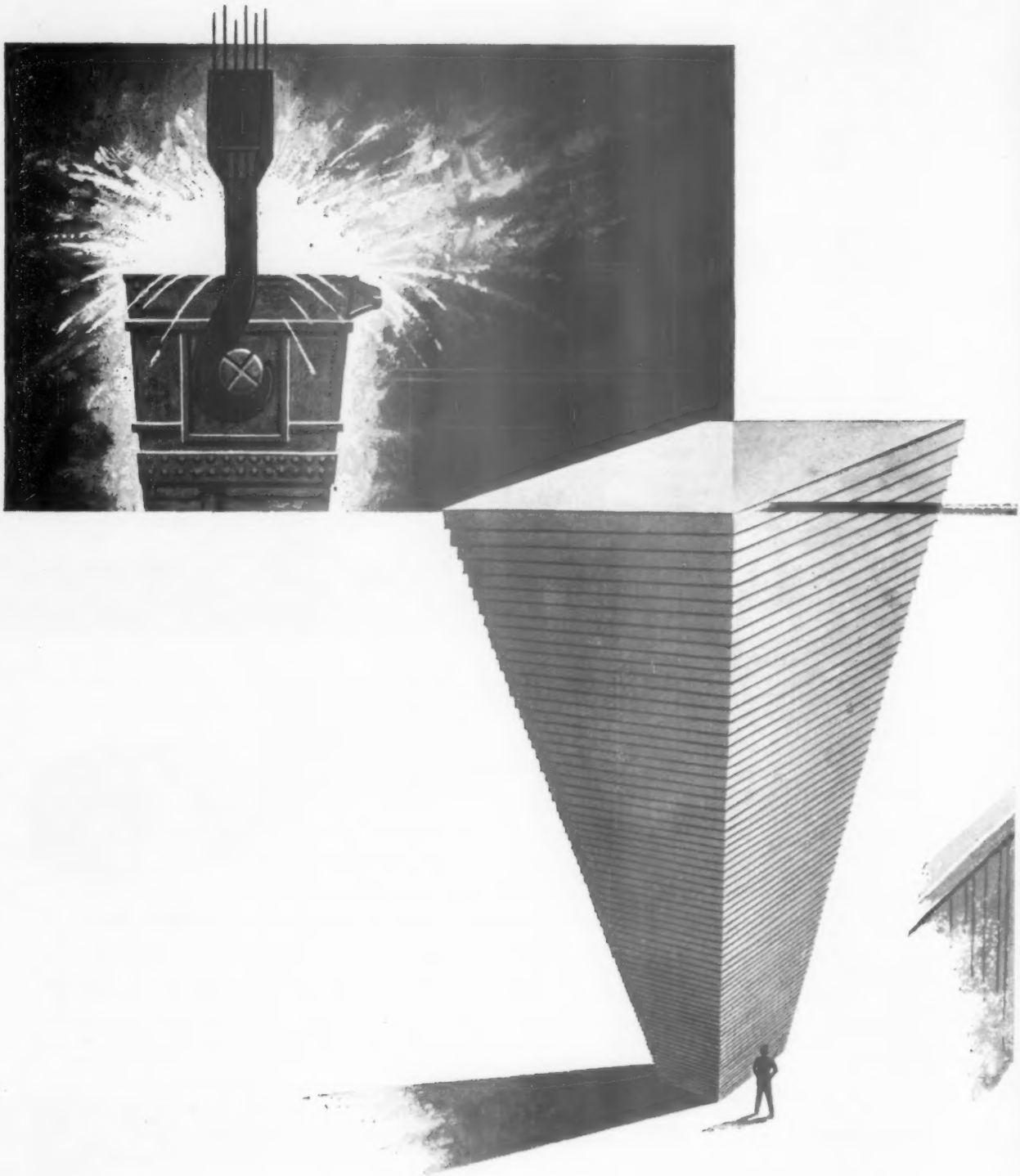

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CF&I-Claymont is the heart of a volcano...

a mountain of plates...

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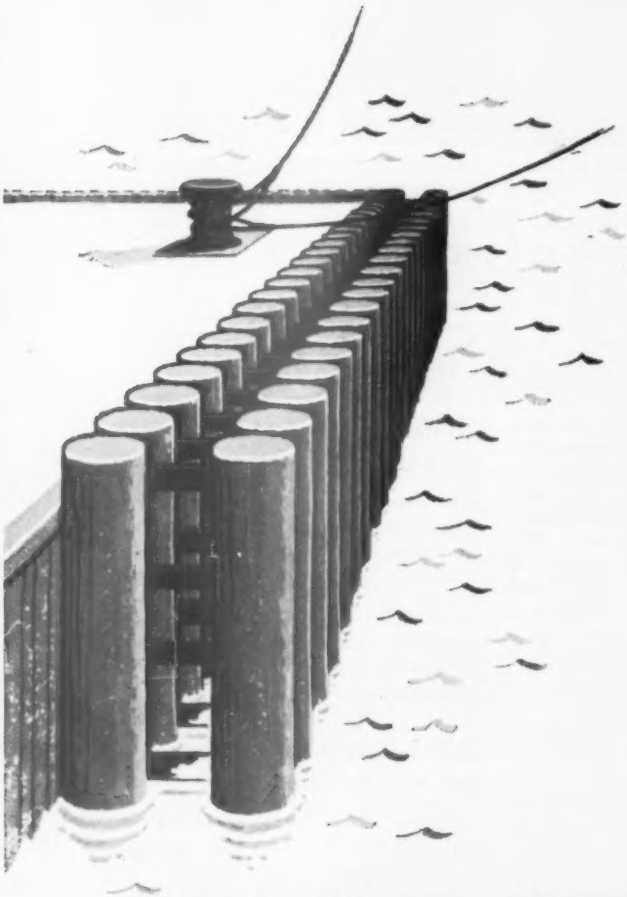

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Claymont is an integrated steel mill. Here, CF&I's pig iron is converted into quality steel. Then the steel undergoes the constant scrutiny of quality control men as it is rolled into plates and shaped into a wide variety of plate products. The result: built-in dependability which is characteristic of all CF&I steel products.

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Territories border—and the minister noted that wells at Clarke Lake, Kotcho Lake and Petitot River "have certain factors in common that lend considerable support to the probability of tremendous gas fields in this general area."

Gas found at Moose Mountain

A SIGNIFICANT natural-gas discovery has been reported by the California Standard Co. and Shell Oil of Canada, about 50 miles west of Calgary at Moose Mountain.

The well is significant for several reasons.

First of all, during the past 50 years, many thousands of dollars have been spent in exploration and drilling in the area, and without success until now.

Secondly, the well, although not the deepest drilled in Canada to date, is one of the deepest, having gone to the 14,010-ft. level. (The deepest to date was more than 15,000 ft.).

Another significant point is that there is no other producing well anywhere near this discovery.

Of significance to California Standard and Shell, joint drillers of the well, is that the well flowed gas at the rate of from 5 to 10 M.M.c.f.d. of natural gas.

The well, Cal Stan-Shell 16-6 Moose Mountain is located about 20 miles west of the Bragg Creek summer resort.

After perforation of a 260-ft. Mississippian interval, between 7,376 ft. and 7,769 ft. (the well was plugged back) the well was given an acid wash.

Further testing will be conducted after the rig has been dismantled. Both Shell and California Standard have individual and joint holdings in the area, and although further drilling is contemplated, no definite plans have been made.

Commonwealth Drilling had the contract on the well.

Elkton gas found at Alberta wildcat

New gas production was tapped in Elkton at Home Oil Co. et al. 10-25 Westcott, LSD 10, 25-31-3w5, 2 miles southeast of East Harmattan field and 40 miles northwest of Calgary.

The Alberta wildcat flowed 7,790 M.c.f.d. on tests of a 52-ft. pay section at 8,100 ft. Location is 6 miles northwest of Carstairs field limits.

Pair of wildcats slated for Northwest Territories

New locations were announced for the Northwest Territories. Imperial Oil Ltd. will drill a pair of wildcats, one at B-72 Cartridge, the other at C-35 Lac Tache. D. Todd Briggs will drill three wildcats in the Trout River district, 65 miles southeast of Fort Simpson.

So far this year, Imperial has drilled two dry holes, and has one drilling. The dry holes were the P-2 Davidson and G-77 Windflower. The driller is B-20 Willow Lake.

Australian well hits basement

In Australia, Exoil Pty., Ltd., exploration subsidiary of Oil Drilling & Exploration, Ltd., reported that 1 Gambanga well reached 1,282 ft. on March 5. A core taken from 1,279-82 ft. revealed a granite basement. An electric log was run to this depth preparatory to abandoning the well.

Geological information received from the drilling of 1 Eyre and 1 Gambanga wells is being evaluated to decide the next stage of the Eucla basin exploration.

Fourth pay expected for Kansas field

In Finney County, western Kansas, Imperial Oil of Kansas, Inc., is promised a fourth pay in Wampler field, a 1959 discovery that flowed 855 bbl. per day from Marmaton Pennsylvanian at 4,278-90 ft.

The 1 Hyer, ½ mile east of the discovery in C SE SW 16-21s-33w, recovered 1,220 ft. of free oil from Lansing-Kansas City during drill-stem test at 4,181-4,215 ft. It then got 2,800 ft. of free oil in Marmaton at 4,263-4,350 and 2,580 ft. of oil from Morrow at 4,563-4,610 ft. Drilling continues in the Mississippian.

Oddly, the north and south offsets to the Wampler were dry in the deep oil zones, but Imperial got a 7 M.M.c.f.d. Krider gas well at the north offset. Skelly made 10,400 M.c.f.d. from Krider at the south offset. Both pay at the 2,500-ft. level, extending Hugoton Permian gas production 2 miles north. The west offset was dry in all zones.

New Mexico bags San Andres strike

San Andres production was opened in northern Lea County in southeastern New Mexico. The discovery well is Roger Harris 1 Federal, 2 miles west of Crossroads townsite.

The well pumped 100 bbl. of 18°-gravity oil and 100 bbl. water on 24-hour test. Production is from perforations at 4,800-80 ft. Location is 3 miles west of Bough field.

Here's California oil picture:

San Emidio Nose duster mars play in California

Kern County's deep San Emidio Nose field made news with a significant dry hole following on the heels of a string of excellent producers. The duster was drilled by Richfield Oil Corp., thus far the only operator with a well in the pool, on a location only two sites north of a producer. The dry hole, 27-4 KCL H, was taken to 12,175 ft. and passed through the Fourth Reef Ridge sand which was unproductive. Richfield also perforated and tested unsuccessfully shallower sand at 4,500-4,950 ft.

One hit, one miss on offshore parcel

Standard Oil Co. of California, as operator for itself and Humble Oil & Refining Co., scored a hit and a miss with the latest two wells drilled on their 5,500-acre offshore lease at Summerland. Wells 11 and 12 were drilled simultaneously from the two-rig platform. No. 11 was completed as a producer while No. 12 was listed as plugged and suspended. No production figures or perforation data were revealed except that No. 11 total depthed at 8,087 ft. and No. 12 at 4,000 ft.

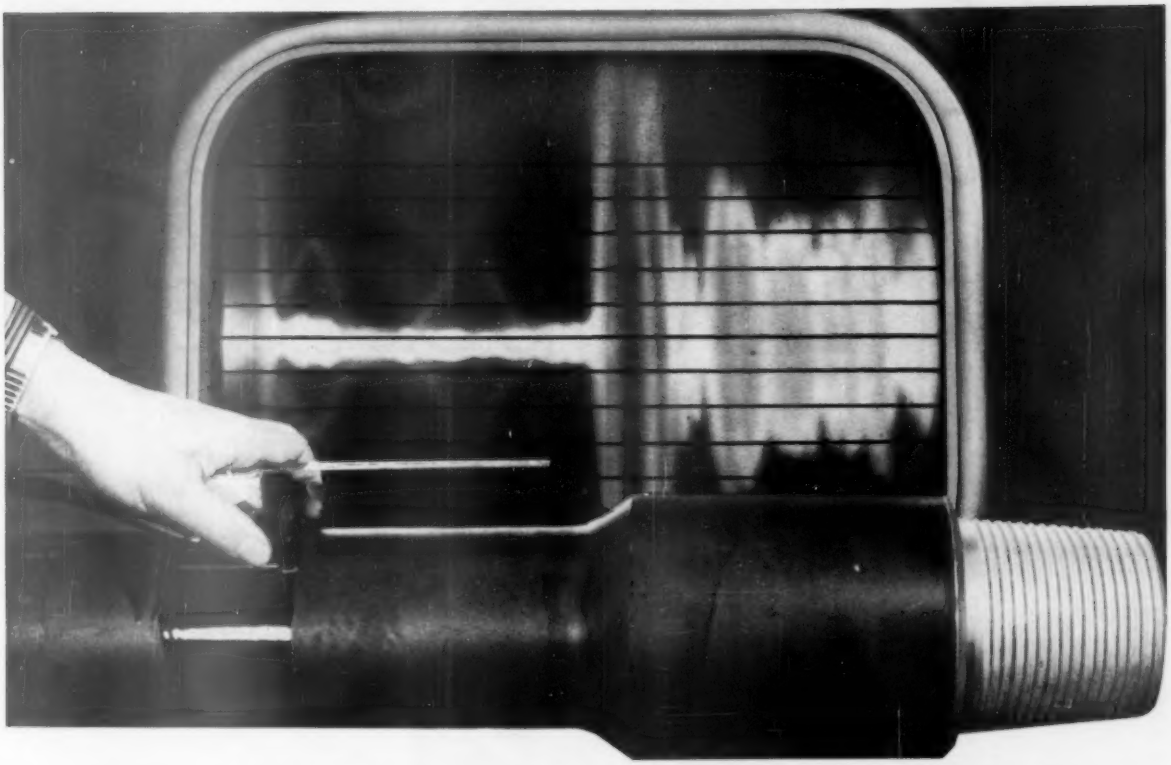
California's Mountain View turns up good well

Another good producer was completed on the north edge of the Stenderup pool play of Kern County's Mountain View field by Kenneth H. Hunter, Jr. The Hunter well tapped the pay sand at 8,490-8,584 ft. Initial production was 240 bbl. daily of clean 34°-gravity crude through a 16/64-in. choke.

Gulf hits with Arbuckle gas test in California

Colusa County's active Arbuckle gas field was credited with another good producer in a well being drilled by Western Gulf Oil Co. on the north edge of the producing area. The Western Gulf well flowed at a rate of 4,390 M.c.f.d. on a test at 5,703-33 ft. and at a rate of 1,150 M.c.f.d. on another test at 6,2862-6,303 ft. The well,

How an electronic signal



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The inspector slowly rotates pipe while holding a high frequency crystal to the exterior. This allows the emitted signal to enter the pipe. The signal bounces off the I.D. at an angle, and returns to the O.D. and then back to the I.D., eventually passing through the weld zone.

If any inclusions or defects are present the return signal will be shown on the screen. The joint is then removed and another joint is welded on.

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new analysis shows how to-

cut drilling costs by $200 per day

If you are using mud as heavy as 12 lbs. per gallon, here is an engineering analysis that shows how you can cut mud costs by using a CLAYJECTOR®.

12-pound mud generally contains about 1½ sacks of barite per barrel. Every time you jet a barrel of mud, you lose barite as well as the clays you are trying to get rid of. This means a monetary loss of over $3.50 per barrel.

Now, if you use three steel tanks, you lose about 100 barrels of mud every time you jet down one foot. Since it is common practice with muds in the 12-pound range, to jet at least one foot per day, that means you jet away something like $400.00 worth of barite, oil and chemicals. With heavier muds, there will probably be less jetting. However, the greater amount of barite and chemicals per barrel means an even greater loss by jetting. You can avoid that loss if you use the CLAYJECTOR to process your mud — rejecting unwanted clays and retaining expensive barite.

Since you get more than 70 per cent clay rejection efficiency with the CLAYJECTOR, you need process only 140 barrels of mud to reject the equivalent of all the clay from about 100 barrels of mud. This low volume of fluid processed keeps oil and chemical losses at a minimum.

Because barite recovery efficiency is 80 to 90 per cent, you lose less than one fifth of the barite in the mud being processed — a negligible amount out of the whole system.

To summarize, you save over $300 for every 100 barrels of mud you would have jetted — if you use the CLAYJECTOR instead of jetting. *Even when you deduct the cost of the CLAYJECTOR, you still can save well over $200 per day.*

This example may not apply precisely to your conditions, but your nearby Swaco sales engineer is ready to help you estimate your probable saving. Call him for more information.

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1 Arbuckle Unit EE, was slated for a total depth of 7,000 ft.

About ¾ mile north of the Western Gulf well, Occidental Petroleum Corp. apparently missed on the first try with a 6,863-ft. extension test and had plugged back and was redrilling after setting a whipstock.

Hopkins field opens in Haskell, Kansas

A pumping potential of 115 bbl. oil daily has been taken by Falcon-Seaboard Drilling Co. at 1 Hopkins "C" in Haskell County, Kansas, opening Hopkins field.

Production is from perforations 5,410-18 ft. Location is C SW SW of 34-30s-33w, 6 miles southwest of Sublette and 10 miles southeast of Santana field.

Gas pay hit at East Kentucky wildcat

In Lawrence County, Kentucky, 3 miles southeast of Blaine and located on Rockhouse Branch of Brushy Creek, Crest Oil Co. has completed 2 Tom Cordle as a gas producer. At a total depth of 1,140 ft. in Mississippian Berea sand, well gaged on open flow 250 M.c.f.d. of gas. Top of Berea was reported at 1,020 ft.

More shallow oil found in southern Kentucky

In southern Kentucky's Clinton County, 7 miles north of Albany, Bill Garry has a new discovery at 1 Shan Mann. The well flowed 100 bbl. of oil in 3 hours from Stone River Silurian at 1,112-19 ft. It is now shut in for tank space. Tops included base of Black shale at 420 ft., Pencil Cave at 1,066 ft. Contractor was Porter Rogers.

Oklahoma's Squaw Creek field is confirmed

In Blaine County, Oklahoma, Sunray Mid-Continent Oil Co. has finaled the 1-A Baker, C NW SE 31-14n-12w, a confirmation test and a zone discovery in Squaw Creek field.

The well tested 814 M.c.f.d. of gas through 20/64-in. choke from perforated intervals at 11,665-11,856 ft. in the Morrow zone. Tubing pressure registered 600 lb.

The discovery well, 1 Baker, C SE SE 36-14n-13w, opened the pool in October and made 41 M.M.c.f.d. of gas with 2.43 bbl. of distillate per million from 10,764-10,806 ft. in the Cherokee sand.

● Sunray has added the 1 Ethel Fry Unit, SE NW 5-2n-26e, Beaver County, Oklahoma, as a gas well in Clear Lake field.

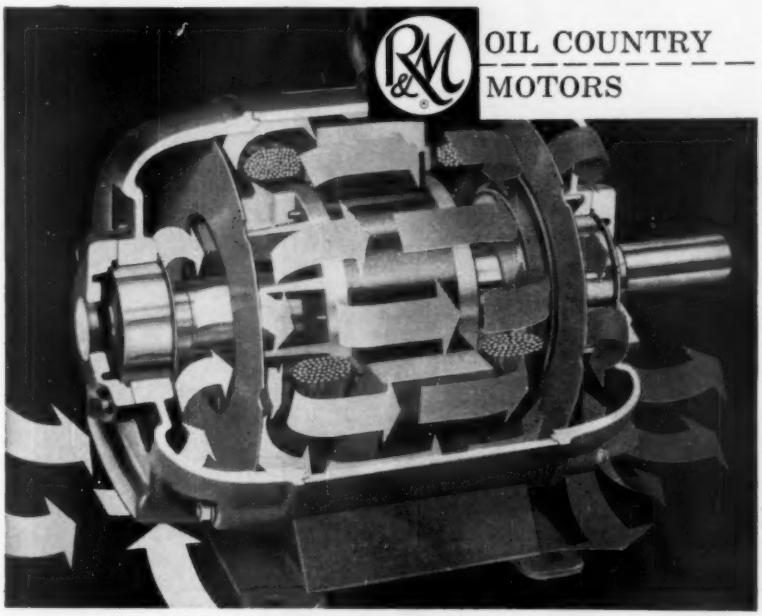
From perforated intervals at 5,760-80 ft. opposite the Tonkawa zone, the well flowed 1,020 M.c.f.d. of gas through 16/64-in. choke. Tubing pressure was 1,400 lb.

Buckeye wildcat to tap deep horizons

In Ohio, Dalton & Hanna have announced a deep test try will be made in Ruggles Township, Ashland County. The location, 1 Arthur Eschtruth, Lot 14, Section 1, is about 1,500 ft. north of Ohio Oil Co. 1 S. V. Kraus also in Lot 14, which was drilled in 1944 to a depth of 5,251 ft. This well had a showing of gas and oil in the Cambro-Ordovician at 4,420-36 ft. but after several months of testing, was abandoned.

Grayburg field opens in West Texas

A Grayburg oil field was discovered in Crockett County, 12 miles southeast of Iraan in West Texas. Discoverer is Williams Petroleum Co., Inc. The discovery well is 1 Dora Hoover



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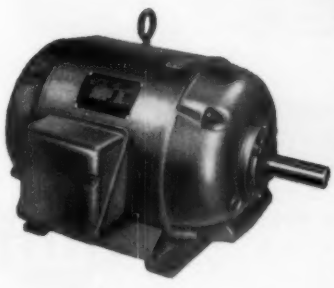

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in Section 6, Block I, GC&SF Survey.

Well pumped 58 bbl. of 30°-gravity oil daily from perforations at 2,162-82 ft.

Wichita Albany hit reported in Texas' Crane

Crane County, West Texas, has a new Wichita Albany oil discovery at Gulf Oil Corp. 59 M. B. McKnight, 22 miles northwest of Crane townsite.

The well flowed 277 bbl. of 35.1°-gravity oil daily plus 13% water on 22/64-in. choke from open hole at 5,356-5,460 ft. Location is Section 24, Block B-17, PSL Survey, on the north side of Running W-Waddell field and 1¾ miles southeast of Armer field.

Tests under way at new Spraberry discovery in Texas

Spraberry production is reported at Amerada Petroleum Corp. 1 A. F. Miles, a Dawson County, West Texas, discovery. The well flowed 483 bbl. of oil and 65 bbl. of water in 24 hours through various chokes from Spraberry perforations between 7,638 and 8,058 ft.

The well also had good showings in Chester Mississippian at 10,840-10,930 ft. and at 11,299-11,430 ft. Location is Section 15, Block 36, T-5-N, T&P Survey, ½ mile northwest of 1 Moore, new West Lamesa-Mississippian field opener.

Mississippian strike completed in North Texas

Mississippian production was opened at Bobby M. Burns 1 Faye W. Weitinger, 1¾ miles north of Markley in Young County, North Texas. The wildcat flowed 140 bbl. of 41°-gravity oil per day on 8/64-in. choke from Mississippian at 2,620 ft.

Location is in the W. C. Adams Survey, A-1364. Nearest Mississippian production is 4½ miles northwest of Archer County Regular field. A trough separates the two areas. New field name is Weitinger Mississippian field.

Caddo production hit in North Texas area

A new Caddo lime oil field was opened in southwestern Montague County, ½ mile southeast of Fruitland in North Texas. The discovery well is McCommons Oil Co. 1 W. J. Owens, 1¼ miles west of Aries Caddo field.

The producer flowed 320 bbl. of

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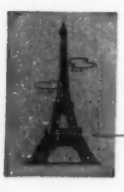

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42°-gravity oil daily from perforations at 5,933-63 ft. Location is Block 94, Panola CSL Survey, A-587. The field will be called Aries West Caddo field.

Palo Duro basin has Permian gas hit

Permian Brown dolomite gas production was officially opened on the north side of Palo Duro basin in the Texas Panhandle.

The discovery well is Texas Gulf Producing Co. 1 Bobbitt in west-central Carson County. Calculated open flow was 9,500 M.c.f.d. from perforations at 3,247 to 3,400 ft. The well's gas has 2% helium content and low BTA. It lies 6 miles south of Panhandle field gas production, separated from that field by a fault on the southwest side of the Amarillo uplift.

Discovery wells

WESTERN CANADA

Alberta:

Brett et al. 6-20 Chin Coulee, LSD 6, 20-7-14w4. Sunburst oil discovery. TD 2,935 ft.

British Columbia:

Texaco-NFA C-52-K Silber, 52-K-94-H-6. Triassic gas discovery. TD 4,100 ft.

SOUTH LOUISIANA

Plaquemines Parish:

Shell Oil Co. 1 State Lease 3604, Township 19s-16e. IP 273 BOPD, 7/64-in., 33°, TP 1,750 psi., GOR 432 cu. ft. per bbl., perf. 11,582-89 ft. TD 12,206 ft. Confirmation well and new-pay discovery in Empire field.

LOUISIANA OFFSHORE

Main Pass Area:

The California Co. 1 State Lease 3466, Block 12, Main Pass, in Black Bay arm of Breton Sound. IP 1,349 M.c.f.d., dry gas, 8/64-in., TP 4,000 psi., perf. 10,079-85 ft. TD 11,000 ft. New-field discovery.

NEBRASKA

Banner County, Bull Canyon:

Edward Mike Davis 1 Patton, C SW SW 17-18n-57w. IPP 187 BOPD, "J" sand discovery, new field. TD 6,862 ft.

NEW MEXICO

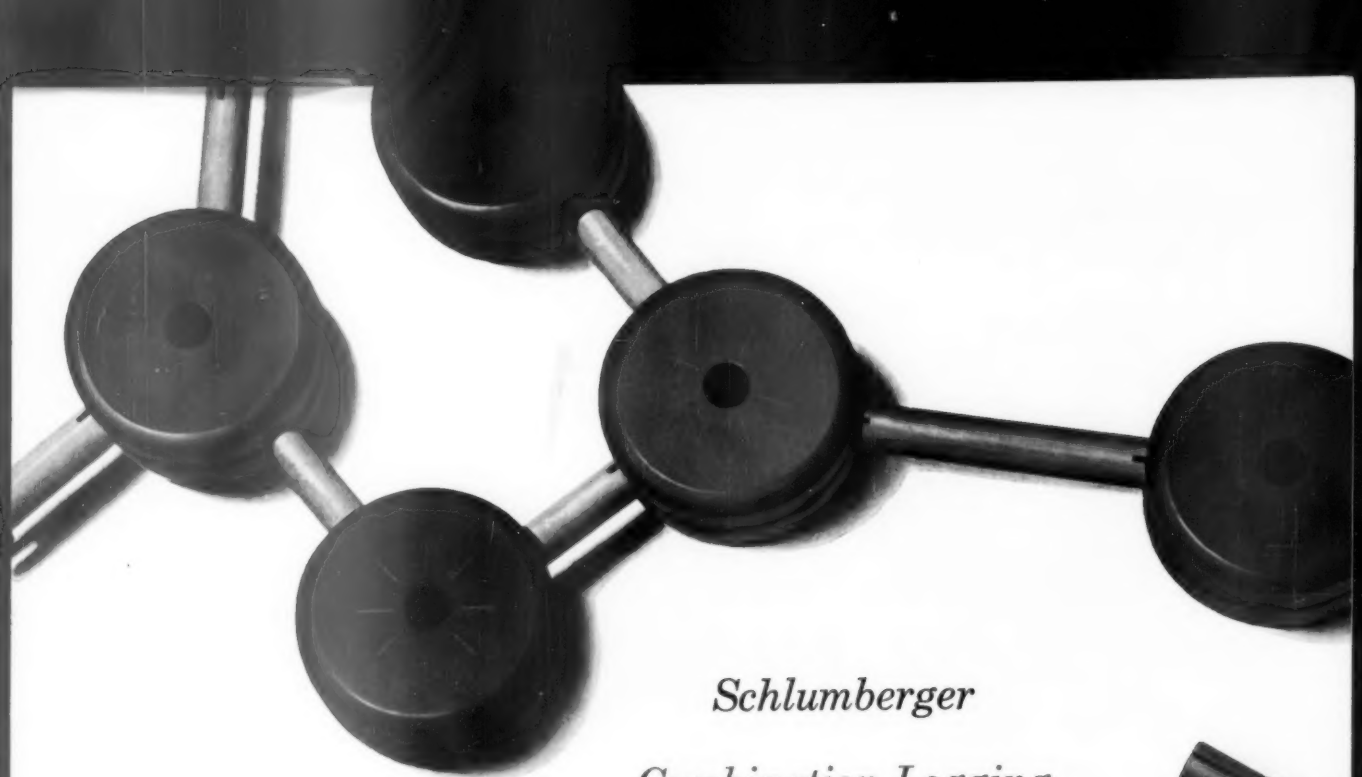
Chaves County:

Kersey & Co. and Earnest A. Hanson 1-YD Federal, 8 miles southwest of Loco Hills in 28-18s-29e. IPF 20 BOPD, 36°, Queen sand 1,983-2,701 ft. TD 3,229 ft. New oil discovery.

SOUTHWEST TEXAS

Jim Wells County:

Cosden Petroleum Corp. and Thodes & Hicks 1 M. A. Bird, Parcel "A," Share 7, Los Presenos de Abajo Grant, A-171, 5 miles northwest of Agua Dulce. AOF 6.6 M.M.c.f.d., GLR 114 M.c.f. per bbl., 38°, shut-in TP 1,821 psi., perf. 5,069-75 ft. and 5,064-70 ft., Bierstadt sand. TD 5,585 ft. Extension and new reservoir-discovery in Captain Lucey area.



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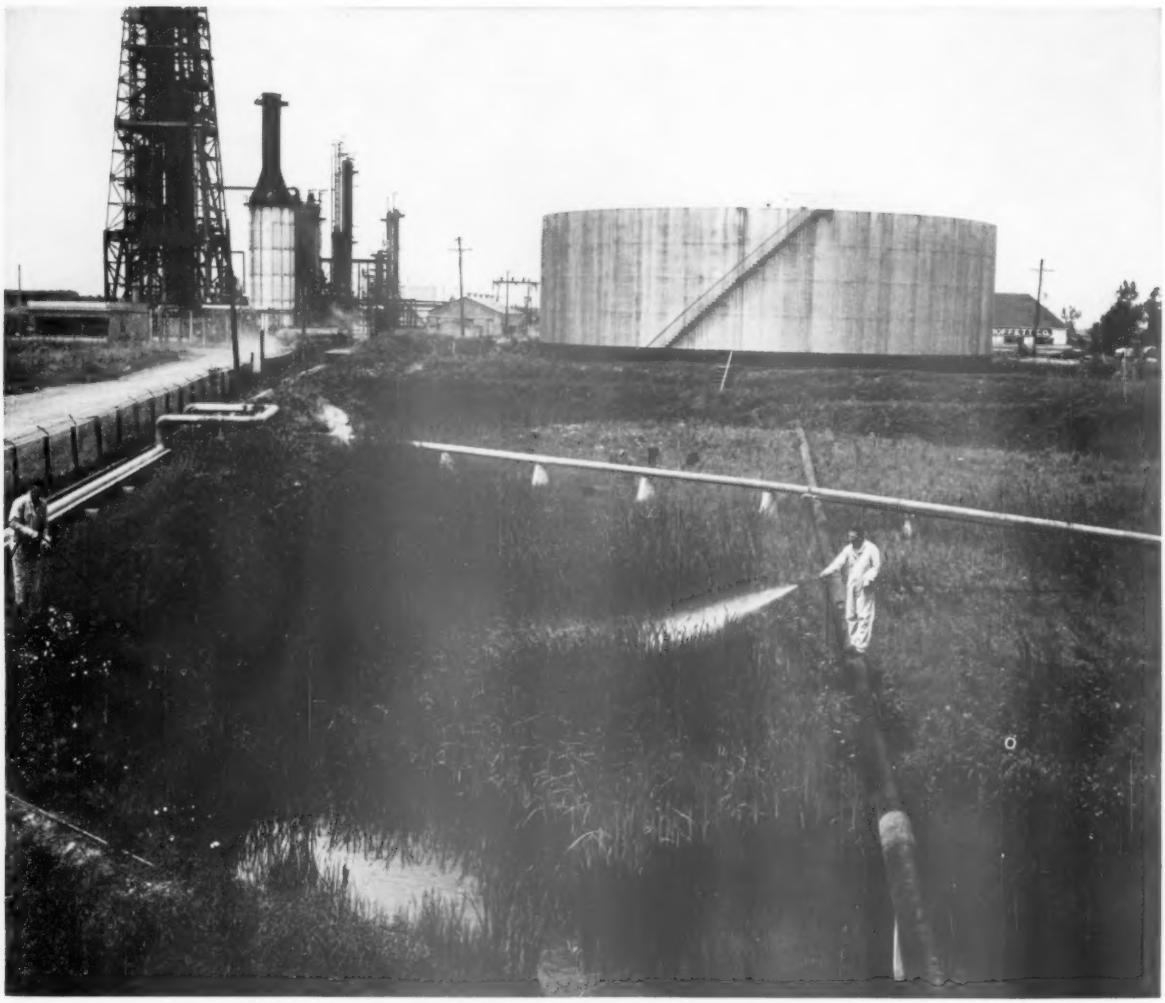

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John C. Johnston . . . Pan Am exploration manager.

Sharper Exploration a Must

. . . in today's dollar-conscious oil operations, according to the new manager of exploration for Pan American.

PAN AMERICAN Petroleum Corp., as a part of a program to get more from its exploration dollar, will expand its efforts this year in Canada and other areas.

A man vitally concerned with this program is John C. Johnston, who recently took over as manager of exploration for Pan American.

Last year the company had an interest in 39 wildcats drilled in Canada. This year that figure is expected to increase to 50, Johnston says.

In Alaska's Bethel basin area, Pan American is drilling the second of three stratigraphic tests to 2,000 ft. to determine the possible reward in a deep test. And the company is conducting other exploration work in the new state.

This interest in the relatively unexplored areas of the northland ties in with Johnston's feeling about dollar-squeezing efforts in the industry.

"The industry as a whole has to better evaluate its exploration efforts," he says, "and direct them into channels which will be most rewarding.

"We must constantly study our results in various areas, closely calculate the potential, and then determine our course.

"I want to emphasize," Johnston says, "that there is a need for more scientific, basic geological and geophysical investigation; for developing new techniques to improve our batting average on the finding of stratigraphic traps."

All in all, Pan American's dollar expenditures for exploration this year will be slightly more than in 1959. But more emphasis will be placed on some activities than last year, and less on others.

"This is simply a matter of spending your dollars where they'll probably do the most good," Johnston points out. "If one kind of activity is not producing the kind of results you feel you must have, then you have to try something else.

"Some things that we've been doing in the past have become pretty well standardized throughout the industry, with the result that you have to be extremely proficient, or very fortunate, to achieve significant new results. And incidentally, that matter of becoming more proficient is something that we are giving a lot of attention to through our research efforts."

A continuing operating problem, Johnston says, is the federal lease restrictions in the Rocky Mountain area which limit options to 200,000 acres and leases to 46,080 acres.

"We are basically concerned here with the present inability to hold enough acreage to conduct a valid exploration program," he asserts.

Background . . . Johnston's interest in geology was sparked by exposed areas in gravel pits and stone quarries near Aurora, Ill., where he was born and lived until he went to college.

He selected the University of Wyoming as the place for him to study geology. There were two principal reasons for the choice: The location was good for surface geology; the year was 1935, and the university had the lowest tuition among institutions offering degrees in geology.

His plan was to study mining geology, but after the first year he switched to petroleum. He earned a bachelor of science degree and a masters.

Johnston joined Pan American as a geologist at Shawnee. He served in the Navy from 1942 to 1946. In 1948, he was named district geologist for the company at Jackson, Miss.

In 1949, he became division geologist at Casper, and 3 years later was promoted to Rocky Mountain division exploration superintendent. Before assuming his present post, he was Texas-Louisiana Gulf Coast division exploration superintendent with offices in Houston.

●

Bill Johnston, geologist with Amerada Petroleum Corp., has been transferred to Casper, Wyo., from Billings, Mont.

Robert L. Schmidt, petroleum engineer for Gulf Oil Corp., has joined the Utah Oil and Gas Conservation Commission as chief petroleum engineer. He succeeds **H. G. Henderson,** who has joined The California Co. as petroleum engineer.

W. F. Burns, formerly district superintendent in Odessa, Tex., for Sinclair Oil & Gas Co., has been named district superintendent in Hobbs, N. M. **R. A. Bonnell, Jr.,** district superintendent in Big Spring, Tex., has been named superintendent of the new Andrews, Tex., district. **T. C. Preston,** formerly in Jackson, Miss., is now Big Spring district superintendent. Also, **L. M. Sellers,** formerly assistant district superintendent in Hobbs, N. M., has been transferred to the new Monahans, Tex., district. **C. G. Confer,** assistant district superintendent in Odessa, has been transferred to Hobbs.

▶▶▶ Personals

John H. Douma, vice president and general manager of Sunray Mid-Continent Oil Co.'s West Coast division, Los Angeles, has been named vice president and manager of the new western division in Denver. The new division is the result of consolidation of the West Coast and Rocky Mountain exploration and production divisions. **O. A. Graybeal,** Sunray's West Coast division production manager, will hold the same position in the western division. **T. A. Clote,** Denver, Rocky Mountain division exploration manager, will be western division exploration manager. Los Angeles personnel involved in the consolidation will be transferred to Denver in June. District offices under the new division will be located in Newhall, Calif., Bakersfield, Calif., Salt Lake City, Casper, Wyo., and Denver.

DOUMA

Fred C. Hands, formerly manager of the Institute, W. Va., synthetic rubber plant of Goodrich-Gulf Chemicals, Inc., has been named director of procurement for the company. He will be in charge of raw material and supply procurement for all Goodrich-Gulf operations.

Robert W. Geehan has been named regional director of U. S. Bureau of Mines in Denver. He had been chief of the office of mineral resources for region 3 in Denver since last June. Geehan succeeds **J. H. East, Jr.,** who has retired.

James G. Baldwin, manager of chemical sales for Collier Carbon & Chemical Corp., has joined Hooker Chemical Corp. as general manager of the western chemical division, Tacoma, Wash. **Horace W. Hooker,** western chemical division sales manager, will be transferred to New York for reassignment this summer. **Russell O. Vognild,** assistant sales manager, will succeed Hooker. **George A. Gentes,** western chemical division production manager, has been named chief engineer for the company. He succeeds **Donald E. Springer,** who recently was named director of corporate engineering. Gentes will headquarter in Niagara Falls, N. Y. **John W. Judy,** technical superintendent in Hooker's Tacoma plant, has been promoted to works manager there.

H. E. Wardlow, production foreman with Mobil Oil Co., has been transferred to Carmi, Ill., from Albion, Ill.

Larry Braden, formerly in Bakersfield, Calif., with Tidewater Oil Co., has been transferred to Regina, Sask., as production manager.

F. E. Meleen, district superintendent for Humble Oil & Refining Co., has been transferred to Stamford, Tex., from Avoca, Tex.

Eric G. Lindroth, Glenn W. Poorman, and **George D. Comnas,** directors of Esso Export Corp., have been named senior vice presidents of the company. Lindroth will be senior vice president for finance; Poorman, for supply; and Comnas, for sales. Comnas also has been appointed a member of the executive committee. Lindroth and Poorman were already committee members.

W. P. Whitmore, executive assistant to the president of Skelly Oil Co., has been promoted to general manager of production. **Leland Franz,** assistant district production superintendent in the western Kansas district, Hutchinson, has been promoted to northern area production superintendent. He will headquarter in Tulsa. Whitmore has been with Skelly since 1946. Franz joined the company in 1953.

C. T. Carter, director of engineering for Sinclair Pipe Line Co., and **Malcolm J. Frazier,** formerly with Sinclair Research Laboratories, Inc., have been elected directors of Sinclair Pipe Line Co. Frazier also has been named secretary - treasurer of Sinclair Pipe Line, succeeding the late John P. Main. Carter succeeds **A. M. Stafford** as a director. Stafford retired last month.

CARTER

FRAZIER

Lyle A. Manor, assistant station construction engineer in Service Pipe Line Co.'s maintenance department, has been named building manager for the company. **S. D. Morris,** formerly chief building engineer in the building service department, will be assistant to Manor. **F. M. Benson,** building superintendent since 1950, has retired.

R. L. Taylor, executive assistant to **L. H. True,** president of Magnolia Pipe Line Co., has been named vice president and a director of the company. **E. J. Wacker, Jr.,** vice president, also has been elected a director. Election of Taylor and Wacker increases board membership to nine. In other appointments, **L. E. Frensley** has been named treasurer and will continue as comptroller of the company. **James R. Ball** has been named assistant secretary and will continue as manager, right-of-way and claims department.

TAYLOR

WACKER

H. R. Rohwedder has been named director of operations for Natural Gas Pipeline Co. of America and Peoples Gulf Coast Natural Gas Pipeline Co., formerly Texas Illinois Natural Gas Pipeline Co. He succeeds **W. T. Bulla,** who has retired. Rohwedder formerly was superintendent of compressor stations for Peoples Gulf Coast. The companies are transmission subsidiaries of Peoples Gas Light & Coke Co.

Frank T. Zitzo, project engineer with Commonwealth Services, Inc., in Houston, has been promoted to chief pipeline engineer.

Frank B. Wright, vice president of Southern Counties Gas Co., has retired after 42 years with the company.

Russell K. Schulze, assistant manager of operations for Shell Oil Co.'s West Coast pipeline department, has been promoted to manager of the department. He succeeds **M. C. Alcorn,** who recently retired. Schulze had been West Coast pipeline assistant since July. He was division superintendent in the products pipeline general field office, Indianapolis, and chief engineer, design and development, in the New York pipeline department before that time.

L. F. McCollum, president of Continental Oil Co., has been elected chairman of Project Hope, sponsored by the People-to-People Health Foundation. The project will send a fully-staffed hospital ship to Southeast Asia in an effort to bring advanced medical knowledge to countries in that area.

▶▶▶ Personals

Larry McIntosh, engineering trainee with Atlantic Refining Co. in Odessa, Tex., has been promoted to junior reservoir engineer in Midland, Tex.

Ted S. Cuellar, assistant chief engineer in Sinclair Oil & Gas Co.'s Silsbee, Tex., gas products plant, has been promoted to Silsbee plant superintendent. He succeeds **W. R. Duhr,** who has retired.

Charles A. Betzel, formerly with Atlantic Refining Co., has joined Petroleum Technologists, Inc., as technical representative.

Richard Wagner, chairman of Champlin Oil & Refining Co., has been elected vice president, north central division, for the Chamber of Commerce of the United States. **Allan Shivers,** chairman of Western Pipe Line, Inc., has been named a director-at-large of the national group.

Paschal Martin, formerly chief production engineer for Pure Oil Co., has joined Ebro Oil Co., Inc., Longview, Tex., as chief engineer. Martin had been with Pure since 1946. He was chief division production engineer in Fort Worth for Pure before being named chief production engineer in Chicago in 1949.

Ian Figart and **Nolan Stewart** have been named vice presidents of Zapata Off-Shore Co. Figart will be in charge of the company's drilling and production operations. He also has been named vice president and a director of Zapata International Corp. Stewart will be concerned with sales, administration, and development of new business. He is also vice president and a director of Zapata International.

J. A. Lester, division geophysicist in Houston for Mobil Oil Co., has been appointed general manager of the company's new geophysical services group. The group will supervise Mobil's geophysical crews in the U. S. and assist in some foreign geophysical operations. In other appointments to the new group, **R. E. Horn,** manager of the field service department in Mobil's Dallas laboratory, has been named superintendent of geophysical field operations. **M. D. McCarty,** manager of the Dallas laboratory, has been named superintendent of engineering and maintenance. **A. W. Musgrave,** research geophysicist, has been named superintendent of special problems.

Paul L. Jeffries has joined Ashland Oil & Refining Co. as petroleum engineer in Henderson, Ky.

Leighton H. Coleman, partner in Davis, Polk, Wardwell, Sunderland, & Kiendl, New York law firm, has been elected a director of American Petrofina, Inc.

Dr. George J. Heuer, Jr., has been promoted to research group leader in Continental Oil Co.'s formation evaluation section, research and development department.

John Sosnowski and **Edward J. Wickson** have been named research associates for Esso Research & Engineering Co. **Franklin W. Church** and **R. R. Johnson** have been named engineering associates.

S. G. Stiles has been named chief mechanical engineer in Shell Oil Co.'s Midland, Tex., area. He succeeds the late J. E. Orrell. Stiles had been on a New York-Hague assignment with Shell since 1959.

J. F. Cooper, supervisor of the process development section at Jefferson Chemical Co.'s Austin, Tex., laboratories, has been named assistant to the vice president for research and development in Houston. **H. G. Muhlbauer,** senior research chemical engineer, has been appointed supervisor of the process development section. **L. P. Benthack,** senior research specialist, will supervise the new semi-works section of the Austin lab.

A. O. Detmar, Mobil Oil of Canada, Ltd., has been named chairman of the 1960 Canadian Petroleum Association board of governors. **J. S. Black,** South Saskatchewan Pipe Line Co., has been named first vice chairman. **E. J. Gallagher,** British American Oil Co., Ltd., will be second vice chairman. Other board members are **A. F. Beck,** Canadian Export Gas & Oil, Ltd.; **R. W. Burns,** Union Oil Co.; **R. W. Campbell,** Home Oil Co., Ltd.; **R. A. Cruickshank,** Canadian Devonian Petroleums, Ltd.; **W. C. Howells,** Texaco Canada, Ltd.; **V. H. Hunter,** Imperial Oil Ltd.; **D. C. Ion,** Triad Oil Co., Ltd.; **G. L. Knox,** California Standard Co.; **C. S. Lee,** Western Decalta Petroleum, Ltd.; **C. O. Nickle,** Conick Petroleums, Ltd.; **F. C. Osment,** Pan American Petroleum Corp.; **L. W. Powell,** British American; **C. R. Spencer,** General Petroleum Drilling Co., Ltd.; **D. M. Tyerman,** McPherson, Leslie & Tyerman; and **J. H. Van de Venter,** Western Natural Gas Co., Inc.

Kenneth R. Joynt, operations superintendent for Mobil Oil Co.'s Houston exploration and producing division, has been named vice president, manager of producing, and a director of Mobil Oil of Canada, Ltd. **Dr. Joseph Spivak,** a director and manager of exploration for Mobil Oil of Canada, has been elected a vice president. Joynt was division superintendent for Magnolia Petroleum Co. in the South Texas and Gulf Coast area before merger of Magnolia and Mobil. Spivak has been with Mobil Oil of Canada since 1944 and has been manager of exploration and a director since 1957.

JOYNT

SPIVAK

Frank B. Markle, Wayne V. Jones, Daniel B. Lovejoy, and **R. C. Frederick** have been named senior vice presidents of the new Union Texas Natural Gas Corp. Frederick will headquarter in Tulsa, where gas-liquids business of the company will be handled. Other senior vice presidents will headquarter in the Houston principal office. Other officers of the new company include **Maxwell L. Euwer,** vice president, producing operations, Houston, **Harold G. Teverbaugh,** vice president, plant operations, Tulsa; **Elliott H. Powers,** vice president, exploration, Houston; **O. M. Bailey,** vice president, marketing, Tulsa; **Claude C. Harris, Jr.,** vice president and Controller, Houston; **W. P. Wyrick,** vice president, Tulsa; **Donald K. Hawes,** secretary and treasurer, Houston; **Russell A. Peterson,** assistant secretary and assistant treasurer, Houston; **L. A. Stuewer,** assistant secretary and assistant treasurer, Tulsa; and **Mrs. Stacey Philp,** assistant secretary, Tulsa. Union Texas was formed recently by merger of Union Oil & Gas Corp. of Louisiana and Texas Natural Gasoline Corp. Chief officers, **Richard T. Lyons,** president, and **John T. Oxley,** executive vice president, were announced earlier (OGJ, Feb. 8, p. 59). Lyons, former president of Union Oil & Gas Corp., will headquarter in Houston. Oxley, former Texas Natural president, will headquarter in Tulsa.

HAMM

PITTS

W. Dow Hamm, manager of domestic and foreign exploration for Atlantic Refining Co., has been named vice president and general manager of crude-oil production. He succeeds **Laurence A. Sunkel,** a director and vice president of Atlantic. Sunkel will work with special crude-oil production activities before his retirement early next year. Atlantic has also named **Dr. Paul M. Pitts** research manager in the research and development department, a new position. He will direct basic research, application research, and development activities. Pitts has been supervising chemist in the research and development department. **W. A. Myers,** acting general manager of the department, will continue to supervise research services and crude-oil production research.

James Souter, geologist with Atlantic Refining Co., has been transferred to Calgary from Billings, Mont.

James O. Staggs, division geologist for McAlester Fuel Co. in Billings, Mont., has been transferred to Magnolia, Ark., as chief geologist for the company. **C. F. Olson,** district geologist in Billings, will succeed Staggs there.

J. H. Sneed, assistant manager and land man in Phillips Petroleum Co.'s southwest region land and geological department, has been named resident manager for Phillips in Tripoli, Libya. **J. W. Bruynzell, Jr.,** geologist for company operations in Jordan, has been named resident geologist in Tripoli.

W. H. Medary, Midland, Tex., district exploration superintendent for Tennessee Gas & Oil Co., has been transferred to Lafayette, La., as district superintendent for onshore and offshore exploration operations. **Robert M. Grace,** district geologist in Midland, will succeed Medary there. In other changes, **Glenn Dille,** geologist, has been promoted to Oklahoma City district geologist. **E. M. Christensen,** land man, has been transferred to Lafayette from Wichita Falls, Tex. **R. F. McMillen,** division unit representative in Denver, has been named unitization supervisor in the exploration properties section, Houston.

Roy Williams, superintendent for Schermerhorn Oil Corp., has been transferred to Chanute, Kans., from Garnett, Kans.

Chester Arinder, production foreman for Superior Oil Co., has been transferred to Grosse Tete, La., from Gladewater, Tex.

C. Stribling Snodgrass has been appointed full-time representative in Europe for Murphy Corp. He will headquarter in London.

Donald O. McCarthy, area superintendent for U. S. Industrial Chemicals Co., has been named assistant production manager for polyethylene resins.

George M. Rose, technical foreman in the cracking area at Tidewater Oil Co.'s Delaware City, Del., refinery, has been promoted to supervisor of the coking area. **Joseph H. Schramm,** staff engineer in the cracking area, will be acting technical foreman, cracking area.

T. M. Sheehy, manager of operations at the Richmond, Calif., refinery of Standard Oil Co. of California, Western Operations, Inc., has been named assistant general manager of the refinery. **R. R. Bowles,** formerly manager of the light oil division, will succeed Sheehy. **W. F. McCullough** will succeed Bowles. Also, **D. C. West** has been named assistant superintendent of the cracking division.

Four mid-continent area oil men will receive American Petroleum Institute citations for service during the API Division of Production Mid-Continent district meeting March 30-April 1. Scheduled to receive awards at the Wichita meeting are **C. E. Rawlins,** Phillips Petroleum Co., Bartlesville, Okla., **W. B. Belknap,** also Phillips, Bartlesville; **E. E. Young,** Sohio Petroleum Co., Oklahoma City; and **Wayne C. Moody,** Sunray Mid-Continent Oil Co., Midland Tex., formerly of Tulsa.

Personals

B. D. Gothard, formerly chief landman for Siebens Leaseholds, Ltd., has been named general manager of the company. He joined Siebens last year.

Warren R. Shepherd, petroleum engineer with Union Oil Co., has been transferred to Houma, La., from Los Angeles.

G. C. Knutson, reservoir engineer with Imperial Oil Ltd. in Edmonton, has been given a 1-year training assignment with Jersey Production Research Co. in Tulsa.

Clifford Yancey has been elected vice president of Rowan Drilling Co., Inc. Yancey will continue to head Rowan's Gulf Coast operations in New Orleans. Yancey has been with Rowan since 1939. He was named division superintendent in 1953 and a director in 1958.

P. R. A. Ensor has been appointed chief representative and general manager, Lebanon, for Iraq Petroleum Co., Ltd. He will also be responsible for IPC operations in Jordan. **G. J. R. Tod** has succeeded Ensor as chief representative, Qatar Petroleum Co., Ltd., and general manager for the company in southeastern Arabia.

George J. Webster, superintendent of quality control for United Carbon Co., has been elected president and general manager of United Carbon France S.A., new French subsidiary of United Carbon. **John Bahm,** international sales manager for the parent company, has been elected a vice president of the subsidiary. Directors are **R. W. French, A. G. Treadgold, H. B. Lawson,** and **Henri de Roubin.**

Deaths

John M. Gardiner, 62, president of Republic Oil Refining Co., and vice president and a director of Plymouth Oil Co., died March 12 in a Pittsburgh hospital.

Clarence Rex Carrothers, 55, right-of-way and claims superintendent for Humble Pipe Line Co., died March 12 in a Houston hospital. Carrothers had been with Humble for 34 years. He was a director of the American Right-of-Way Association and past president of the association's gulf states chapter.

Ralph J. Karr, 38, senior research engineer with Continental Oil Co. in Ponca City, Okla., died March 9 in an Oklahoma City hospital of injuries received in a traffic accident. Karr had been with Continental since 1957.

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"OIL MINDED"
There are 18 men affiliated
with the industry on our
Board of Directors and Advisory Directors

FIRST CITY
NATIONAL BANK OF HOUSTON

Loans on oil or gas producing properties, secondary recovery, refining plants, pipe lines and many others.

HOUSTON, TEXAS

MEMBER
FEDERAL DEPOSIT
INSURANCE CORPORATION

A quick look at the highlights . . .

	LATEST WEEK	Change from WEEK AGO*		Change from YEAR AGO	
Production	7,088,380	DOWN	106,260	DOWN	68,400
Crude stocks	252,715,000	DOWN	434,000	DOWN	3,286,000
Completions	685	DOWN	54	DOWN	153
Refinery runs	7,782,000	DOWN	140,000	DOWN	501,000
Gasoline stocks	221,125,000	UP	1,697,000	UP	10,835,000
Kerosine stocks	20,536,000	DOWN	1,720,000	UP	1,548,000
Distillate stocks	91,176,000	DOWN	10,526,000	UP	12,300,000
Residual stocks	43,227,000	DOWN	982,000	DOWN	11,783,000
Four-product stocks	376,064,000	DOWN	11,531,000	UP	12,900,000
Total imports	1,765,500	DOWN	127,700	UP	27,600

*Product stocks for March 4 revised.

Snow was not what the refiner ordered

BY JOHN C. CASPER

END-OF-WINTER weather has been a mixed blessing for the refiner. In fact, there may have been more loss than gain in the mixture.

Weather has made the news for the past few weeks, not because of low temperatures but because highway-blocking snows were covering much of the eastern half of the country.

The series of snow storms can be credited with late-season increases in deliveries of distillate fuel, but they played havoc with highway travel and gasoline consumption.

Ideal winter weather for the oil marketer is sunshine with low temperatures and a good wind. He had some sunshine and cool weather in November, but even here the 13% increase in distillate demand for the month was misleading because the comparison was with a very low demand for November 1958.

The charts on this page show total demand for gasoline and middle distillates during the first-quarter months over a period of 4 years. Figures for January and February this year were calculated from weekly data reported by API. March totals are based on first-of-the-month trends with the assumption that weather for the last half of the month will be more nearly normal.

If the recent series of snow storms happens to last through the last half of March, gasoline demand will be lower than indicated by the bar on the gasoline chart.

Take a look at the chart showing total gasoline demand. The first group of bars pictures January demand for the past 4 years. Current weekly figures indicate a decrease of almost 2.0% from the record set in January 1959. This loss was more than offset by the gain in February. Averages for the two months show a small increase over last year.

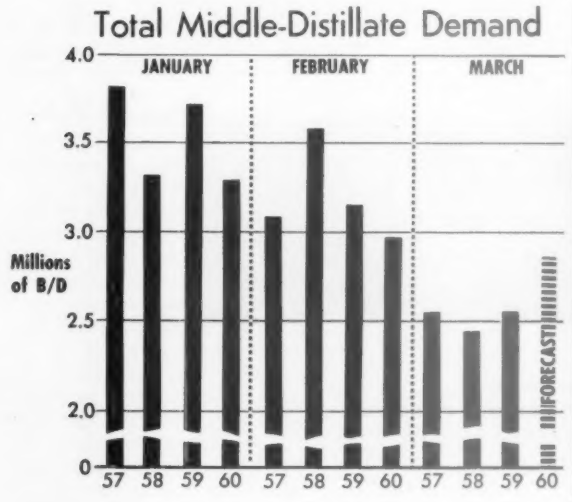
Demand for gasoline in March, assuming better weather in the last half of the month, is forecast at 3,800,000 bbl. daily or 2.1% less than the all-time March record set last year. For the first quarter, gasoline demand is expected to be down only about 0.6% from last year's record total of 3,755,000 bbl. daily.

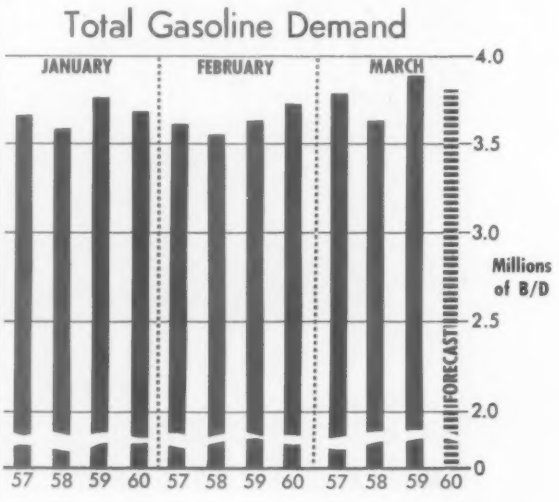
But the big losses will be in fuels. Based on near-normal weather for the last half of March, middle-distillate demand for the quarter will be off almost 100,000 bbl. daily or 3.1%.

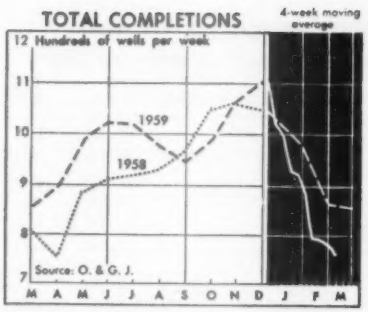
Residual demand is not shown on the charts, but the average for the current quarter is expected to be down about 100,000 bbl. daily from the all-time record of 2,088,000 bbl. daily reported for the first quarter last year.

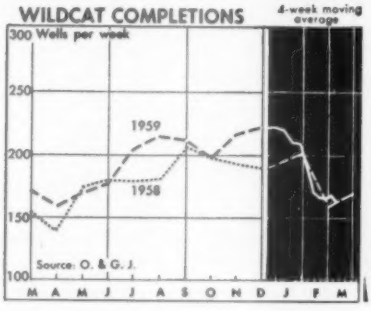
Four-product demand for March will show a gain over March 1959, but the average for the first quarter will be down about 2.5%.

Demand for all products will be nearer last year's figure since the total will include LPG and lubricants which have been showing good gains.









Active Rotary Rigs

	3-14-60	3-7-60	3-16-59
Alabama	5	4	7
Arkansas	12	15	19
Arizona	1	1	0
California	80	84	94
Land	79	79	91
Offshore	1	5	3
Colorado	19	18	27
Florida	2	1	2
Land	1	0	2
Offshore	1	1	0
Illinois	17	15	14
Indiana	4	4	4
Iowa	0	0	3
Kansas	107	99	124
Kentucky	4	5	4
Louisiana	287	294	301
North	26	22	28
S. Inland waters	127	138	134
S. Land	81	87	99
Offshore	53	47	40
Maryland	0	0	1
Michigan	37	39	17
Mississippi	67	63	59
Missouri	0	0	0
Montana	16	12	17
Nebraska	24	22	23
Nevada	0	0	0
New Mexico	93	98	93
New York	0	0	0
North Dakota	13	11	36
Ohio	3	3	1
Oklahoma	175	180	217
Oregon	0	0	0
Pennsylvania	6	6	13
South Dakota	1	0	1
Texas	590	598	725
S. Inland waters	8	8	6
S. Land	162	164	156
Offshore	2	0	1
North	39	40	156
East	34	41	(*)
Panhandle	48	50	(*)
West Central	199	198	252
West	98	97	154
Utah	26	25	35
Washington	0	0	0
West Virginia	5	4	5
Wyoming	57	55	53
Total U. S.	1,651	1,656	1,895
Western Canada	232	241	215
Eastern Canada	3	3	0
Grand total	1,886	1,900	2,110

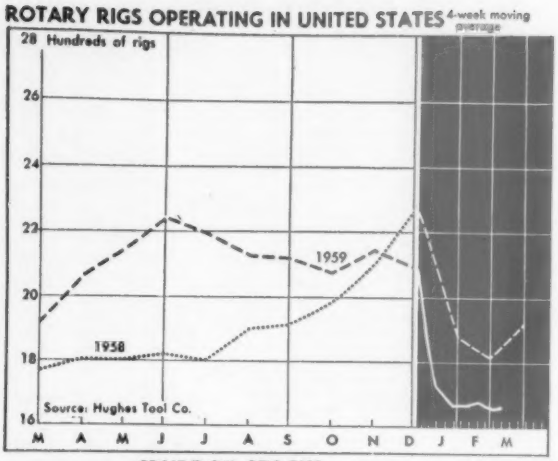
Hughes Tool Co. report. *Included in North. Comparisons not available due to change in method of reporting.

WEEKLY WELL COMPLETIONS . . . WEEK ENDED MARCH 12, 1960

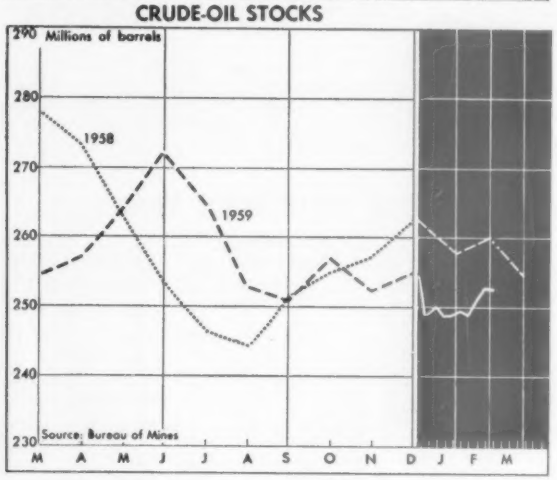
	Total wells							Cum.		Total wildcats					Cum.	
	Total	Crude	Cond.	Gas	Dry	Service	Footage	1960	1959	Total	Crude	Cond.	Gas	Dry	1960	1959
Alabama	0	0	0	0	0	0	0	8	25	0	0	0	0	0	1	4
Arizona	0	0	0	0	0	0	0	6	.....	0	0	0	0	0	6	.....
Arkansas	10	4	0	0	6	0	33,691	125	196	2	0	0	0	2	33	35
California	24	14	0	0	10	0	112,157	260	324	3	0	0	0	3	59	74
Colorado	19	3	0	0	16	0	77,661	146	157	5	0	0	0	5	69	84
Illinois	22	10	0	0	12	0	42,677	482	135	6	0	0	0	6	126	41
Indiana	13	3	0	0	10	0	15,337	195	455	7	0	0	0	7	79	73
Kansas	52	27	0	0	25	0	181,724	683	815	22	3	0	0	19	211	191
Kentucky	48	28	0	6	14	0	57,654	442	366	4	2	0	0	2	50	42
Louisiana	55	21	9	3	22	0	532,978	650	747	8	0	0	0	8	94	106
North	12	5	0	2	5	0	51,938	206	272	3	0	0	0	3	40	51
South	27	9	6	1	11	0	288,781	330	392	4	0	0	0	4	48	53
Offshore	16	7	3	0	6	0	192,259	114	83	1	0	0	0	1	6	2
Michigan	12	6	0	0	6	0	44,528	146	115	3	0	0	0	3	49	36
Mississippi	10	7	0	0	3	0	88,573	153	131	3	0	0	0	3	57	62
Montana	3	1	0	0	2	0	12,958	52	57	0	0	0	0	0	26	24
Nebraska	15	5	0	0	10	0	95,456	150	141	4	0	0	0	4	61	64
New Mexico	27	21	0	2	4	0	125,849	384	353	2	1	0	0	1	56	36
West	8	5	0	2	1	0	17,327	127	.....	0	0	0	0	0	11	.....
East	19	16	0	0	3	0	108,522	257	.....	2	1	0	0	1	45	.....
New York	0	0	0	0	0	0	0	72	74	0	0	0	0	0	5	4
North Dakota	5	5	0	0	0	0	32,753	61	88	0	0	0	0	0	10	23
Ohio	15	6	0	3	6	0	38,306	242	182	0	0	0	0	0	12	5
Oklahoma	61	36	3	4	16	2	255,158	747	1,176	11	3	0	3	5	147	191
Pennsylvania	0	0	0	0	0	0	0	67	59	0	0	0	0	0	5	1
South Dakota	1	0	0	0	1	0	8,724	10	.....	1	0	0	0	1	4	.....
Texas	254	139	14	14	84	3	1,160,054	3,202	3,783	59	2	1	0	56	664	716
Dist. 1	18	11	1	1	5	0	64,878	234	242	5	0	0	0	5	85	64
Dist. 2	8	2	3	0	3	0	58,158	128	152	3	0	1	0	2	33	46
Dist. 3	21	9	3	0	9	0	169,865	260	222	3	0	0	0	3	51	65
Dist. 4	14	1	3	1	9	0	99,236	249	260	6	0	0	0	6	74	77
East	16	10	1	0	5	0	97,118	244	225	3	0	0	0	3	50	54
Dist. 7-B	22	8	0	0	14	0	72,507	434	491	11	0	0	0	11	129	134
West	71	50	1	3	17	0	321,016	851	1,193	13	1	0	0	12	137	129
Dist. 9	60	37	0	3	17	3	168,045	592	718	11	1	0	0	10	88	118
Dist. 10	24	11	2	6	5	0	109,231	210	280	4	0	0	0	4	17	29
Utah	8	3	0	0	5	0	46,176	57	78	2	0	0	0	2	21	18
West Virginia	14	2	0	11	1	0	33,461	174	149	0	0	0	0	0	1	5
Wyoming	17	10	0	1	6	0	71,643	199	173	4	0	0	0	4	78	67
Miscellaneous	0	0	0	0	0	0	0	6	15	0	0	0	0	0	5	12
Total U. S.	685	351	26	44	259	5	3,067,518	8,719	9,794	146	11	1	3	131	1,929	1,914
Previous week	739	330	25	70	293	21	3,320,100	.....	.....	172	14	3	3	152	.....	.....
Cum. 1960	8,719	4,064	283	770	3,333	269	37,775,899	.....	.....	1,929	177	19	58	1,675	.....	.....
Cum. 1959	9,794	4,949	255	656	3,670	264	41,947,836	.....	.....	1,914	205	26	65	1,618	.....	.....
Western Canada	73	31	0	9	23	0	378,918	484	475	23	2	0	2	19	141	178

PRODUCTION

ROTARY RIGS OPERATING IN UNITED STATES



CRUDE-OIL STOCKS



CRUDE-OIL STOCKS BY STATES OF ORIGIN*

(Thousands of barrels)

	3-5-60	2-27-60	3-7-59
Pennsylvania	2,212	2,268	2,507
Other Appalachian	1,985	1,947	1,556
Illinois, Indiana, Michigan	9,607	9,340	8,741
Nebraska and North Dakota	2,615	2,570	2,158
Kansas	9,075	9,291	8,822
Oklahoma	16,855	17,471	15,674
Arkansas	2,101	1,988	1,933
Louisiana	19,556	19,341	17,702
North	3,086	3,179	2,885
South	16,470	16,162	14,817
Mississippi, Alabama, Florida	2,889	2,924	2,541
New Mexico	7,628	7,442	8,741
Texas	107,215	108,357	112,938
East Texas	7,890	7,990	8,916
West Texas	49,767	50,422	55,425
Texas Gulf	18,105	18,593	19,612
Other Texas	31,453	31,352	28,985
Wyoming	17,382	17,228	13,042
Other Rocky Mountain	9,324	9,437	9,132
California	29,510	28,856	35,044
Foreign	†14,761	14,689	15,470
Total	**252,715**	253,149	256,001

*Bureau of Mines. †Includes 3,891,000 bbl. in California.

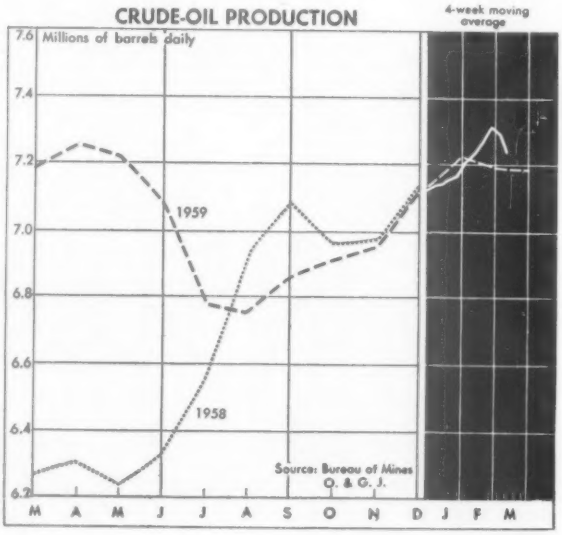
DAILY AVERAGE PRODUCTION FOR WEEK

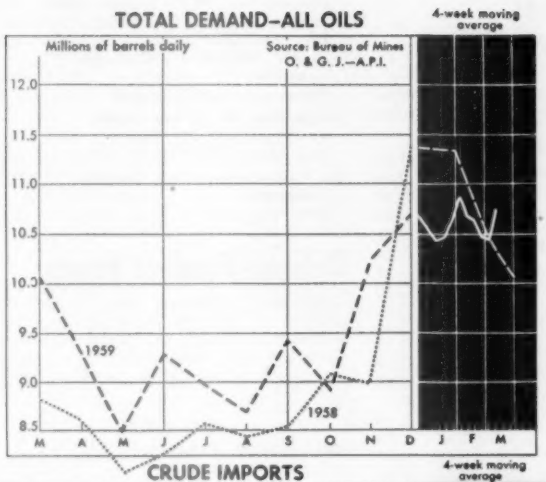
	March 12, 1960			
	Crude oil	Lease condensate	Total	Mar. 5 total
Alabama	19,300	.....	19,300	19,325
Arkansas	82,800	300	83,100	84,475
California	828,300	.....	828,300	829,700
Colorado	129,000	.....	129,000	130,700
Eastern	37,600	.....	37,600	37,000
Florida	1,200	.....	1,200	1,225
Illinois	216,500	.....	216,500	213,700
Indiana	33,700	.....	33,700	33,600
Kansas	†258,930	.....	†258,930	†274,990
Kentucky	67,500	.....	67,500	67,200
Louisiana	964,250	133,650	1,097,900	1,094,900
North	109,250	6,150	115,400	115,400
South	855,000	127,500	982,500	979,500
Michigan	31,600	.....	31,600	31,800
Mississippi	134,100	4,225	138,325	139,150
Montana	80,500	.....	80,500	79,400
Nebraska	63,000	.....	63,000	63,500
Nevada	100	.....	100	100
New Mexico	306,600	8,500	315,100	311,375
North Dakota	51,300	.....	51,300	60,600
Oklahoma	†508,700	.....	†508,700	†551,900
Texas	2,583,000	91,625	2,674,625	2,727,350
Dist. 1	41,000	3,500	44,500	44,500
Dist. 2	114,000	9,100	123,100	125,250
Dist. 3	325,000	38,000	363,000	375,850
Dist. 4	190,000	17,000	207,000	207,000
Dist. 5	29,000	500	29,500	28,650
Dist. 6	114,000	10,000	124,000	126,150
East Texas field	139,000	.....	139,000	142,425
Dist. 7-B	137,000	300	137,300	138,150
Dist. 7-C	127,000	3,525	130,525	131,825
Dist. 8	1,067,000	6,000	1,073,000	1,103,850
Dist. 9	192,000	2,400	194,400	194,400
Dist. 10	108,000	1,300	109,300	109,300
Utah	109,400	.....	109,400	93,600
Wyoming	341,400	.....	341,400	347,700
Others	‡1,300	.....	‡1,300	‡1,350
Total U. S.	6,850,080	238,300	**7,088,380**	7,194,640
Change from previous week, down			**106,260**	
Canada	†513,100	.....	†513,100	†618,500

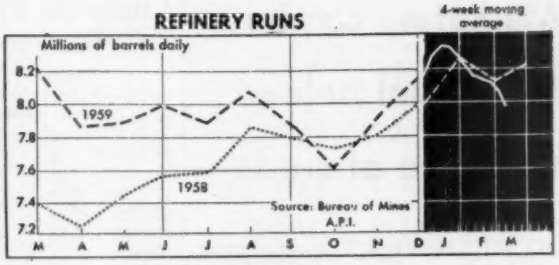
Total U. S. production—Jan. 1-Mar. 12 ..... 519,987,400 bbl.
Same period last year (crude plus cond.) ..... *511,593,900 bbl.

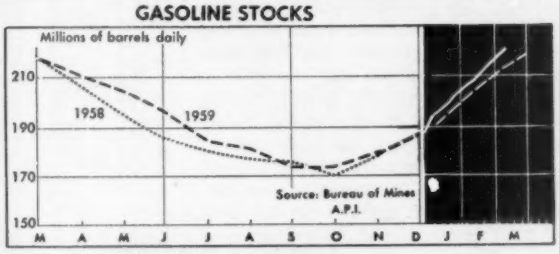
*Includes 14,013,200 bbl. condensate. †Week ended previous Monday. ‡Alaska and South Dakota.

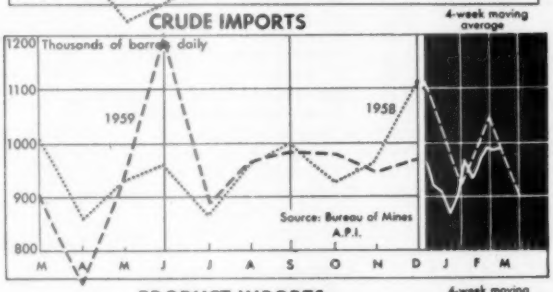
CRUDE-OIL PRODUCTION

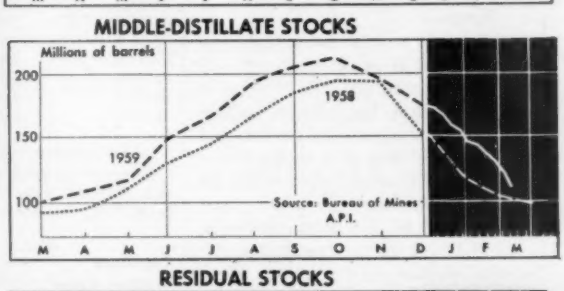


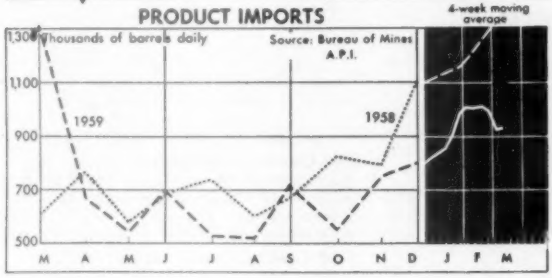

TOTAL DEMAND—ALL OILS
4-week moving average
Millions of barrels daily
Source: Bureau of Mines
O. & G. J.—A.P.I.
1959
1958
M A M J J A S O N D J F M

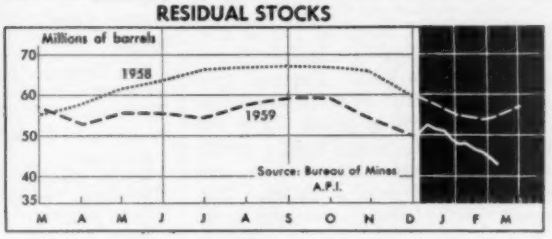












API REFINERY REPORT—MARCH 11, 1960

(Thousands of barrels)

District—	Daily avg. runs	Daily average production Gaso.*	Kero.	Dist.	Resid.	Stocks‡ Gaso.†	Kero.	Dist.	Resid.	Bureau of Mines, March 1959 Daily avg. runs	Daily average production Gaso.*	Kero.	Dist.	Resid.
East Coast	1,024	481.2	33.4	306.6	168.4	45,596	7,780	30,637	11,483	1,202	534.5	49.1	394.9	191.5
Appalachian:														
District 1	95	34.9	5.0	17.6	13.6	6,130	492	2,121	258	104	41.6	4.6	24.6	10.6
District 2	110	54.3	9.2	19.4	16.3	3,129	357	889	412	103	48.0	8.2	17.2	18.3
Ind., Ill., Ky.	1,439	695.3	60.4	289.3	189.3	43,373	3,650	14,246	4,003	1,519	759.1	72.3	332.3	192.4
Minn., Wis., Dak.	103	43.1	1.0	24.7	21.4	7,148	639	3,447	543	103	50.0	5.4	25.8	10.6
Okla., Kans., Mo.	701	389.1	14.6	168.6	47.2	22,550	885	7,671	891	738	395.8	13.7	184.3	26.2
Inland Texas	279	185.9	8.9	51.9	17.7	8,263	430	1,483	2,414	272	200.4	6.2	41.2	21.9
Tex. Gulf Coast	1,831	907.0	112.1	424.4	168.1	27,516	2,354	11,185	5,090	1,927	925.8	100.4	488.7	181.8
La. Gulf Coast	669	399.7	72.7	154.2	49.7	11,768	1,755	3,835	960	700	379.2	31.2	187.5	51.1
N. La. and Ark.	102	46.4	4.1	20.7	6.7	5,626	747	2,296	169	102	49.2	5.0	24.1	6.3
Rocky Mtn:														
New Mexico	28	17.7	.71	4.4	3.7	800	72	165	153	25	12.5	.50	4.4	2.5
Other	299	129.6	4.6	63.7	31.7	7,763	252	2,234	926	295	134.6	3.8	63.5	38.6
West Coast	1,102	564.7	27.0	190.1	334.3	31,463	1,123	10,967	15,925	1,117	499.7	5.5	198.9	298.7
Mar. 11, 1960	7,782	3,948.9	353.7	1,735.6	1,068.1	221,125	20,536	91.176	43,227	8,207	4,030.4	305.9	1,987.4	1,050.5
Mar. 4, 1960	7,922	4,062.3	§338.7	1,713.1	941.6	§219,428	§22,256	§101,702	§44,209	.....	.....	.....	.....	.....
Mar. 13, 1959	8,283	4,061.7	330.7	2,027.0	1,047.7	210,290	18,988	78,876	55,010	.....	.....	.....	.....	.....

*At refineries including natural blended. †Finished and unfinished. ‡At refineries, bulk terminals, in transit, and in pipelines. §Revised.

Marketers can buy No. 2 fuel below the price of crude

DO YOU HAVE a little extra clean storage? Do you have cheap transportation from the Gulf Coast refining area? Do you market distillate heating oils? If so, you may be able to save some money by buying heating oils at the end of this season rather than at the start of the next one.

Some suppliers are taking a good look at costs and comparing distressed distillate prices with the total cost of producing distillates at their own refineries.

Distillate fuels can be bought on the Gulf Coast at prices that are well below formal postings. The posting is 8.0 cents a gallon, but a buyer willing to take a few cargoes before the end of March could buy at a much lower price. General market information on the Gulf Coast is that this posting can be discounted by 0.5 cent or more. Th. emphasis is on the "more."

At the middle of the month there was a rumored cargo of No. 2 fuel offered at 7.75 cents a gallon, delivered in New York. Current spot tanker rates for clean Gulf-East Coast movement is about .25% off the USMC rate. On this basis, a rough estimate of total transportation cost would be 0.75 cent a gallon. This would give a netback on the Gulf Coast of about 7.00 cents a gallon or less than the price of crude.

Distillate at 7.00 cents a gallon wolud be $2.94 a barrel. Most East Texas crude sells for $3.25 a barrel at the well. Sour West Texas crude is posted at $2.95 for 40° gravity. Wellhead prices for light-type crudes from Southwest Texas and the Lower Gulf Coast range near $3.20 a barrel for 40° gravity and $3.12 for 36° gravity. The refinery price will be higher since it will include gathering and pipeline charges.

The buyer of 7.00-cent distillate would be gambling against a general reduction in the price of crude, but at the present the odds seem to be in his favor.

Group 3 gasoline is up 0.25 cent a gallon, but the increase was offset in part by a reduction in the spot price for No. 2 fuel, off 0.25 cent. The spread between No. 1 and No. 2 fuels has increased to 1.00 cent a gallon from 0.75 cent.

Crude-Oil Prices

GRAVITY SCHEDULE

	Signal Hill, Calif.	Oklahoma	Gulf Coast Tex.*	West Tex.† N.M.	Wyo. (sour)
14-14.9	$1.76	....	....	....	....
15-15.9	1.84	....	....	....	$1.81
16-16.9	1.92	....	....	....	1.86
17-17.9	2.00	....	....	....	1.91
18-18.9	2.08	....	....	....	1.96
19-19.9	2.16	....	....	....	2.01
20-20.9	2.24	$2.49	....	$2.35	2.06
21-21.9	2.32	2.52	....	2.38	2.11
22-22.9	2.39	2.55	....	2.41	2.16
23-23.9	2.46	2.58	$3.44	2.44	2.21
24-24.9	2.53	2.61	3.46	2.47	2.26
25-25.9	2.60	2.64	3.48	2.50	2.31
26-26.9	2.67	2.67	3.50	2.53	2.36
27-27.9	2.74	2.70	3.52	2.56	2.49
28-28.9	2.81	2.73	3.54	2.59	2.54
29-29.9	2.87	2.76	3.56	2.62	2.59
30-30.9	2.93	2.79	....	2.65	2.63
31-31.9	3.00	2.82	....	2.68	2.67
32-32.9	3.06	2.85	....	2.71	2.71
33-33.9	3.12	2.88	....	2.74	2.75
34-34.9	3.17	2.91	....	2.77	2.79
35-35.9	3.22	2.94	....	2.80	2.83
36-36.9	3.27	2.97	....	2.83	2.87
37-37.9	3.31	2.99	....	2.86	2.89
38-38.9	....	3.01	....	2.89	2.91
39-39.9	....	3.03	....	2.92	2.93
40-40.9	....	3.05	....	2.95	2.95

*Low cold test crude. †Sour.

Effective dates of broad changes: California, 9-11-59; East of California, January 3-10, 1957; Pennsylvania Grade 1-11-60.

FLAT PRICES

Louisiana:	
Sweet Lake	$3.00
Texas:	
East Texas	3.05-3.25
Conroe	3.23-3.53
Van	3.08
Pennsylvania Grade:	
Bradford	4.55
Middle District	4.37
Southwest Pennsylvania	4.10
West Virginia	3.92
Buckeye Grade	3.77
Illinois Basin	**3.00**

FOREIGN

Canada:	
Leduc-Woodben	2.53
Redwater (Alta.)	2.42
Smiley (Sask.)	2.18
Pembina	2.38
Venezuela:	
Cumarebo, 48°-9°, Tucupido	3.34
San Joaquin, 41°-41.9°, Puerto La Cruz	3.08-3.10
Oficina, 35°-35.9°, Puerto La Cruz.	2.80
Tia Juana medium, 26°-26.9°, Amuay*	2.30
Quiriquire, 16.0°-16.4°, Caripito	2.10
Lagunillas heavy, flat, Las Piedras*	2.10
Bachaquero, flat, 15°-16°, Las Piedras*	1.88

Prices for all crudes of 24° or lighter vary 2 cents per degree change, up or down. All crudes heavier than 24° vary 2.5 cents per half-degree gravity change.

*Also available at La Salina at 3 cents per barrel less.

Middle East, Persian Gulf (cargoes f.o.b. lifting port):	
Arabian, about 34°, Ras Tanura	$1.90
Iranian, 34.0°-34.9°, Bandar Masur	1.80
Iranian, 34.0°-34.9°, Abadan	1.81
Iraq, 36.0°-36.9°, Fao	1.82
Kuwait, 31.0°-31.9°, Mina-al-Ahmadi	1.67
Qatar, about 41°, Um Said	2.05
Middle East, E. Mediterranean:	
Arabian, about 35°, Sidon	2.29
Iraq, about 35°, Tripoli, Banias	2.29
Far East (cargoes, f.o.b. Lutong, Sarawak):	
Seria Light, 37°	2.57

Refined-Product Prices

Following quotations are for refinery products in cents per gallon moving in interstate shipments on Wednesday each week unless otherwise noted. Crude-oil prices are per barrel at the wells unless otherwise listed.

GASOLINE*

Mid-Continent (Group 3):	
★Regular (91 octane)	11.00-11.25
★Premium (99 octane)	13.50-14.00
Natural gasoline (26-70)	4.5
Breckenridge	4.0
Gulf Coast (cargoes for coastwise or export movements):	
Regular (90 octane)	10.25-10.50
Regular (92 octane)	10.50-10.75
★Premium (98 octane)	11.50-11.75
California (rack) Los Angeles):	
Regular (88 octane)	11.65-12.15
Premium (94 octane)	12.65-13.15
Premium (100 octane)	14.00-14.65
Caribbean area (cargoes):	
Regular (87 octane)	10.125
Premium (97 octane)	11.75

*Quotations are for octanes shown. Prices usually vary with octane ratings within the regular, premium, and aviation grades.

KEROSINE AND DISTILLATE

Mid-Continent (Group 3):	
★Kerosine 42-44	9.25- 9.50
★Diesel oil (58 d.i. and above	9.00- 9.25
★Distillate No. 1	9.00 9.25
★Distillate No. 2	8.00- 8.25
Gulf Coast (cargoes):	
Kerosine 41-43	8.75- 9.00
Distillate No. 2	7.75- 8.00
New York Harbor (barges):	
Kerosine 41-43	9.8-10.3
Distillate No. 2	8.8- 9.3
Diesel fuel, 48-52 d.i.	9.1- 9.6
Caribbean area (cargoes):	
Distillate No. 2	8.00

RESIDUAL FUEL (BBL.)

Mid-Continent (Group 3):	
Residual fuel (max. 1% S)	$1.70-1.80
Gulf Coast (cargoes):	
Bunker C fuel	$2.00
New York Harbor (barges):	
Bunker C fuel	$2.37
Caribbean (cargoes):	
Bunker C	$2.00
California (rack):	
Bunker C fuel, Los Angeles	$2.15

Tanker Rates (Long Ton)

Latest reported spot fixtures)

★Gulf-N. Y., clean (ATRS—21%)	$2.25
★Gulf-N. Y., dirty (ATRS—30%)	2.00
★Carib.-N. Y., dirty (ATRS—47.5%)	1.44
★PG-Japan, dirty (USMC—71%)	2.96

★Denotes change from previous week.

More discovery wells

COLORADO

Moffat County, Elk Springs:
Continental Oil Co. 1 M. V. Smith, OWWO, SE SW 30-5n-98w. IPF 3,300 M.c.f.d., 2-in. choke, TP 210 psi. OTD 6,231 ft. Dakota discovery, new pay at Elk Springs.

MISSISSIPPI

Monroe County:
J. R. McLean-A. G. Hill 1 Brasfield-Boyd Unit, NW NW SW 31-13s-17w. IPP 27.3 BOPD (net), 3 BWPD, 20.5°, GOR 93 cu. ft. per bbl., perf. 2,563-87 ft., Carter sand (Mississippian-Chester). TD 3,584 ft. Elev. 400 ft., Devonian 3,440 ft. Discovery well of South Amory field.

MONTANA

Glacier County, Cut Bank area:
Kullberg & Otthouse Drilling Co. et al. 3-S-1 Tribal, SW SW 36-36n-7w. IPF 260 BOPD, 52°, Madison 3,615-18 ft. TD 3,690 ft. Madison discovery, new field.

Musselshell County, Ivanhoe Dome:
Winston L. Cox 1 Northern Pacific, SE NW 17-11n-31e. IPF 277 BOPD, 16/64-in. choke, 31.9°, Amsden 3,493-3,516 ft. TD 4,209 ft. Amsden discovery, new pay.

Sheridan County:
Mobil Producing Co. F-44-20-P Mueeler, C SE SE 20-32n-59e. IPP 51 BOPD, 49 BWPD, 32.9°, Mission Canyon 8,011-12 ft. TD 12,033 ft. Mission Canyon discovery, new field in Dwyer area.

OHIO

Ashtabula County:
Felmont Oil Corp. and Sun Oil Co. 1 M. Hudson, Lot 22, Pierpont Twp. IPF 1,627 M.c.f.d. Oriskany 2,356-61 ft. Rock pressure 950 psi. TD 2,361 ft.

NORTH TEXAS

Archer County:
Jack Grace Production Co. 1 O'Donohoe "A," 1½ miles east of Mankins field. IPF 864 BOPD, ½-in. choke, GOR 615 + 1, TP 250 psi., CP 600 psi. 42°, Ellenburger 4,965-87 ft. TD 4,994 ft. New oil discovery.

SOUTHWEST TEXAS

Dimmit County:
Haynes & V. T. Drilling Co. 5 Minnie W. Clark et al., T. Sanchez Sur., A-665, 1 mile south of Carrizo Springs. IP 73 BOPD, ¼-in., 39°, TP 450 psi., GOR 450 cu. ft. per bbl., perf. 2,901-06 ft., Olmos. TD 3,168 ft. New pay in East Wintergarden field.

Hidalgo County:
C. A. Jennings 1 E. Vento, Monterrey Branco Sur. 89, 7 miles southwest of Donna. AOF 7 M.M.c.f.d., GLR 135 M.c.f. per bbl., 61.9°, shut-in TP 3,556 psi., perf. 7,980-8,000 ft., Frio. TD 8,238 ft. New pay in Landa field.

Starr County:
Flourney Production Co. et al. 1 Leonor Garza et al., Share 10, La Sal Colorado Grant, 1 mile south of Santa Elena, IP 250 M.c.f.d., 10 BCPD, perf. 4,664½-70½ ft., Frio. TD 6,500 ft. New-field discovery.

Owen & Moss 2 Marrs McLean Trust, Share 1-A, Porcion 79. IP 427 M.c.f.d., ¼-in., TP 313 psi., perf. 827-34 ft., Frio. TD 1,675 ft. New pay in West Zim field.

Arkansas Fuel Oil Corp. 1 La Brisa-State, Section 540, CCSD&RGNG Sur., A-896, 10 miles northeast of Garciasville. AOF 3, 5 M.M.c.f.d., GLR 18.1 M.c.f. per bbl., 59.8°, shut-in TP 3,292 psi., perf. 6,660-80 ft., Vicksburg, and 860 M.c.f.d., GLR 30 M.c.f. per bbl., 49.1°, shut-in TP 3,515 psi., perf. 6,832-35 ft., Vicksburg. TD 9,051 ft. New-field discovery.

Webb County:
Bill Pearl Drilling Co. 1 O. W. Killam, Section 1569, 20 miles east of Laredo. IPP 47 BOPD, 20.8°, perf. 1,079-85 ft., Yegua. TD 1,500 ft. Discovery well of Oro Negro (proposed) field.

E. J. Pearl et al. 2 O. W. Killam, Lot 15, Section 1,569. IPP 54 BOPD, 22.4°, perf. 1,184-88 ft., Yegua. TD 1,260 ft. New pay in Oro Negro field.

TEXAS GULF COAST

Bee County:
Lively, Marino & Appell 1 Angeline Wood, Share 4, J. B. Madray Sur., A-239, 3 miles southwest of Yougeen. IP 27 BOPD (net), 53.2 % water, 20/64-in., 22°, TP 275 psi., GOR 200 cu. ft. per bbl., perf. 3,783-86 ft., Vicksburg. TD 4,216 ft. New-pool discovery south of Yougeen field.

Colorado County:
Skelly Oil Co. 1 L. B. Clinton, G. Strawschneider Sur., A-40, 2 miles northeast of Altair. AOF 7,300 M.c.f.d., GLR 35.5 M.c.f. per bbl., 49.6°, shut-in TP 2,650 psi., perf. 10,176-90 ft., Wilcox. TD 11,026 ft. Discovery well of Brandon field.

Jackson County:
H. H. Howell et al. 1 Gertrude T. Hanna, Section 8, John J. Linn Sur., A-213, 6 miles south of Edna. AOF 25 M.M.c.f.d., GLR 58,530 cu. ft. per bbl., shut-in TP 2,425 psi., perf. 6,186-95 ft., Frio. TD 6,950 ft. New pay in South El Toro field.

Katz Oil Co. 1 Volney Simons, Lot 10, Huston Ranch Subd., William B. Bridges Sur., A-9, 4 miles northwest of Edna. AOF 8,200 M.c.f.d., dry gas, shut-in TP 1,145 psi., perf. 2,575-80 ft., Catahoula. TD 5,210 ft. New reservoir discovery in Carmichael area.

Jasper County:
Atlantic Refining Co. 1 H&TC Fee 65, in H&TC Sur.. Section 65, 1 mile northwest of Call. IP 206.52 BOPD, 10/64-in., 41.8°, TP 1,100 psi., GOR 782 cu. ft. per bbl., perf. 8,885-95 ft., Wilcox. TD 10,300 ft. Discovery well of Call Junction (proposed) field.

Jefferson County:
Shell Oil Co. 39 McFaddin Trust, Sarah A. Pace Sur., A-783, 12 miles west of Sabine Pass. IP 98 BOPD, 7/64-in., 34°, TP 470 psi., GOR 429 cu. ft. per bbl., perf. 5,900-08 ft., Miocene, and 96 BOPD, 7/64-in., 34°, TP 580 psi., GOR 438 cu. ft. per bbl., perf. 5,810-16 ft., Miocene. TD 6,600 ft. New pays in Clam Lake field.

Live Oak County:
Frank Waters Oil Co. 1-A Benton Allen, Section 2, GH&H Sur., 25 miles northwest of Alice. AOF 1,540 M.c.f.d., GLR 62.6 M.c.f. per bbl., 64.3°, shut-in TP 1,760 psi., perf. 4,768-4,808 ft., Pettus. TD 5,730 ft. New-reservoir discovery in Ramirena area.

DeLange, Neathery & Schimmel 1 Mollie Marsden et al., Dennis McGowan Sur., A-29, 3 miles southeast of Oakville. IP 110 BOPD, ⅛-in., 28°, TP 7,531 psi., perf. 7,531-46 ft., Wilcox. TD 7,740 ft. New-pool discovery in Marsden area.

Matagorda County:
Pan American Petroleum Corp. 3 C. G. Harvey, Section 34, James McFarland Sur., 8 miles northeast of Palacios. IP 241.75 BOPD, 16/64-in., 37.9°, TP 425 psi., GOR 393 cu. ft. per bbl., perf. 9,051-58 ft., Frio. TD 9,136 ft. New-pay discovery in Palacios field.

Pel-Tex Petroleum Co., Inc., and R. M. Well Servicing & Drilling Co. 1 B. W. Trull et al., P. W. Grayson League, A-43. AOF 1,900 M.c.f.d., GLR 40,480 cu. ft. per bbl., 61°, shut-in TP 2,940 psi., perf. 8,578-98 ft., Frio. TD 8,640 ft. Revives and extends abandoned one-well Trull field.

Newton County:
Oil Reserves Corp. 2-K Kirby-Cochran, Henry Cochran Sur., A-64, 3 miles northeast of Bleakwood. IP 253.62 BOPD, 11/64-in., 37.5°, TP 615 psi., GOR 327 cu. ft. per bbl., perf. 8,052-57 ft. Wilcox. TD 11,056 ft. Discovery well of Bleakwood (proposed) field.

Refugio County:
Pakawa Oil Co., Inc., 1-A Mrs. Rae Wood Welder, Section 18, J. C. Wood Subd., CEPI&M Sur., 9 miles west of Refugio. AOF 42.5 M.c.f.d., dry gas, shut-in TP 1,125 psi., perf. 2,643-45 ft., Oakville. TD 5,842 ft. New-field discovery.

San Patricio County:
Gulf Coast Minerals Management Corp. and Miller & Fox 1 J. F. Odem et al., Archibald Herron Sur., A-166, ½ mile east of Sinton. AOF 6 M.M.c.f.d. dry gas, shut-in TP 735 psi., perf. 1,887-92 ft., Miocene. TD 6,805 ft. New-field discovery.

Coastal States Gas Producing Co. and H. C. Heldenfels, Trustee, et al. 1 D. I. Coggin, Sect. 10, 1st Addition Taft Farm Lands, 5 miles north of Taft. AOF 86 M.M.c.f.d., GLR 200 M.c.f. per bbl., 58°, shut-in TP 2,325 psi., perf. 6,208-11 ft., Frio. TD 8,500 ft. Extension and new-reservoir discovery in Taft area.

Wharton County:
M. E. Andrews III 1 W. J. Grady, William Vess Sur., 9 miles northwest of El Campo. AOF 58 M.M.c.f.d., dry gas, shut-in TP 1,925 psi., perf. 4,723-29 ft., Frio. TD 5,510 ft. New-field discovery (West El Campo).

Andrews & Smith, Inc., 1 E. E. Reitz, William Vess Sur., 6 miles northwest of El Campo. AOF 18.5 M.M.c.f.d., dry gas, shut-in TP. 2,017 psi., perf. 5,047-50 ft., Frio. TD 5,410 ft. New pay in West El Campo (proposed) field.

Willacy County:
William G. Gill et al. 2 Ches and Robert Todd, Section 1, Narcisco Tract No. 4, 6 miles west of Raymondville. IP 112 BOPD, 1% water, ⅛-in., 36°, TP 1,125 psi., GOR 1,050 cu. ft. per bbl., perf. 4,656-60 ft. TD 6,027 ft. New pay in La Sara field.

WEST CENTRAL TEXAS

Brown County:
K. S. Richards 1-B Pat Warren, 1 mile west of Thrifty, SW¼ Sec. 32, HT&BRR Sur. IPF 5.81 BOPD, 34°, open-hole top pay 2,295 ft. TD 2,362 ft. New oil discovery.

WEST TEXAS

Ector County:
Diversa, Inc. et al. 1-A J. D. Amburgey, 7 miles southwest of Notrees, Sec. 3, Blk. B-8, PSL. IPP 186 BOPD, 35°, Clear Fork 6,382-6,552 ft. TD 7,970 ft. New oil discovery.

King County:
Pan American Petroleum Corp. 1 R. B. Masterson III, 11 miles northeast of Guthrie in Sec. 36 Blk. A, R. M. Thompson Sur. IPP 110 BOPD, 34°, Bunger sand 4,015-19 ft. TD 6,202 ft. New oil field.

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ADVERTISERS
in this issue

ACF Industries, Incorporated, W-K-M Division ... 8
Ajax Iron Works ... 26
Allison Division, General Motors ... 152
American Iron & Machine Works Company, Inc., Subsidiary of American Machine & Foundry Company ... 179
American Machine & Foundry Company, American Iron & Machine Works Company, Inc., Subsidiary ... 179
American Meter Company ... 173
Anderson Company, The V. D. ... 145
Astranaut, Inc. ... 145
Atlas Pipe Inc. ... 37

B & W Inc. ... 153
Baker Oil Tools, Inc. ... 66
Bank of Montreal, The ... 70
Baroid Division, National Lead Co. 10, 11, 59
Bendix Aviation Corporation ... 146
Bethlehem Steel Company ... 95
Supply Division ... 39
Black, Sivalls & Bryson, Inc. ... 183
Bowen Itco, Inc. ... 32
Bower Roller Bearings, Federal-Mogul Service Division of Federal-Mogul-Bower Bearings, Inc. ... 12
BrakeSol, Inc. ... 128
Braniff International Airways ... 165

Caterpillar Tractor Co. ... 30, 147
Chain Belt Company ... 144
Cherokee Laboratories. Inc. ... 49
Chiksan Company ... 47
Chiyoda Chemical Engineering & Construction Co., Ltd. ... 48
Classified Advertising ... 198, 199, 200
Colorado Fuel and Iron Corp. ... 176, 177
Cook Machinery Co., Inc. ... 128
Core Laboratories, Inc. ... 167
Crose Perrault Equipment Corp. ... 128

Dallas Mfg. Company ... 145
Deming Company, The ... 45
Dover Corporation—The W. C. Norris Manufacturer Division ... 164
Dow Chemical Company, The ... 186
Dowell ... 1, 142
Drilco Oil Tools Inc. ... 42
Drilling Equipment Manufacturing Co. 155
Drilling Specialties Co. ... 158
du Pont ... 3

Federal-Mogul Service Division of Federal-Mogul-Bower Bearings, Inc. ... 12
First City National Bank of Houston ... 191
First National Bank of Shreveport, The 154
Fischer & Porter Co. ... 131
Fisher Governor Company ... 19
Fort Worth National Bank, The ... 58

Garrett Oil Tools, Division U. S. Industries, Inc. ... 171
Gaso Pump & Burner Mfg. Co. ... 34, 35
Gates Rubber Co., The ... 40
Geophysical Service, Inc., ... 163
Grant Oil Tool Company ... 151
Grinnell Company, Inc. ... 5
Grove Valve and Regulator Company 14
Guiberson Corporation ... 44

Halliburton Oil Well Cementing Company ... Inside Front Cover, 6, 7, 83
Hercules Tool Company ... 173
Hillman-Kelley ... 175
Hughes Tool Co. ... Back Cover
Humble Oil & Refining Co. ... 9
Hutchison Manufacturing Company ... 172

Jensen Bros. Mfg. Co., Inc. ... 150
Jo-Bell Products, Inc. ... 147
Johnston Testers, Inc. ... 36

Jones & Laughlin Steel Corporation 112, 113
Jones & Laughlin Supply Division 156, 157
Jones Company, The S. M. ... 27

Kelley Company, Ben F. ... 169

Liberty Mutual Insurance Company ... 2
Link-Belt Company ... 15
Lufkin Foundry & Machine Co. ... 28

Macco Oil Tool Co. ... 142
Magnet Cove Barium Corp. ... 33
Martin, Manufacturer, John N. ... 143
Martin-Decker Corp. ... 141
Masterseal Company ... 155
McGaffey-Taylor Corp. ... 154
Mid-Continent Supply Company ... 174
Milwhite Mud Sales Company ... 168
Minneapolis-Honeywell Regulator Company ... 16, 51, 52, 53, 54
Mission Mfg. Company ... 61
Moore Corporation, Lee C. ... 57

National Bank of Commerce, The ... 24
National Bank of Tulsa ... 50
National Lead Company ... 17, 18
National Tank Company ... 202
Nordstrom Valve Division, Rockwell Manufacturing Company ... 41
Norris, Manufacturer, W. C., Division of Dover Corporation ... 164

Odex Engineering Company ... 139
Oil Center Tool Co. ... 25
Oil Well Supply Division ... 4
Olin Mathieson Chemical Corporation, Chemicals Division ... 114
Onan & Sons Inc., D. W. ... 20, 21
Otis Engineering Corporation ... 62

Paris Distributor, Inc., Henry H. ... 184
Parkersburg Rig & Reel Co. ... 182
Petroleum Electric Power Assn. ... 29
Pfizer & Co., Inc., Chas. ... 134
Philco Corporation ... 149
Porter Company, Inc., H. K.—Thermoid Division ... 60
Price Company, H. C. ... 64

Reda Pump Company ... 141
Reed Roller Bit Company ... 132, 133
Republic Steel Corporation ... 136, 137, 138
Robbins & Myers, Inc. ... 181
Rolo Manufacturing Company ... 39
Roper Hydraulics, Inc. ... 140

Salt Water Control, Inc. ... 180
Sargent Engineering Corporation ... 111
Sauder Tank Co., Inc. ... 155
Schlumberger Well Surveying Corp. ... 185
Shaffer Tool Works ... 166
Southwest Industries, Inc. Inside Back Cover
Stauffer Chemical Company ... 46
Sumitomo Metal Industries, Ltd. ... 31

Taylor Instrument Companies ... 68, 69
Texaco Inc. ... 13
Thermoid Division of H. K. Porter Company, Inc. ... 60
Thompson Pump Company ... 154
Thompson Tool Co. ... 170
Toronto-Dominion Bank, The ... 63

Union Asbestos and Rubber Company, Fibrous Products Division ... 43
United States Steel Corporation—Oil Well Supply Division ... 4

Visco Products Co., Inc. ... 55

Waukesha Motor Company ... 38
Williams & Co., J. H. ... 22, 23
W-K-M Division of ACF Industries Incorporated ... 8

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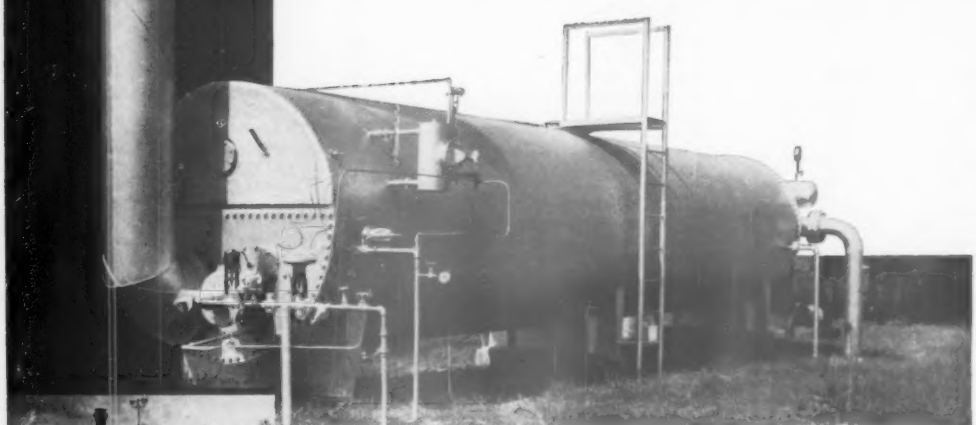

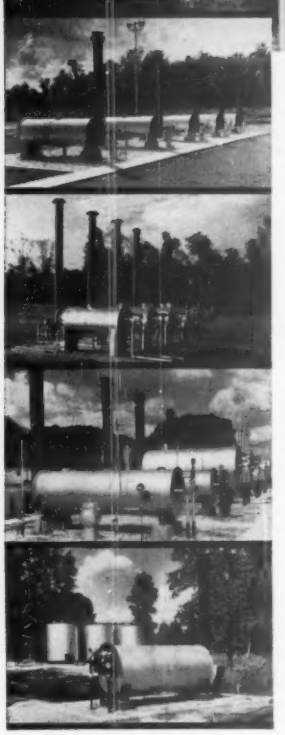

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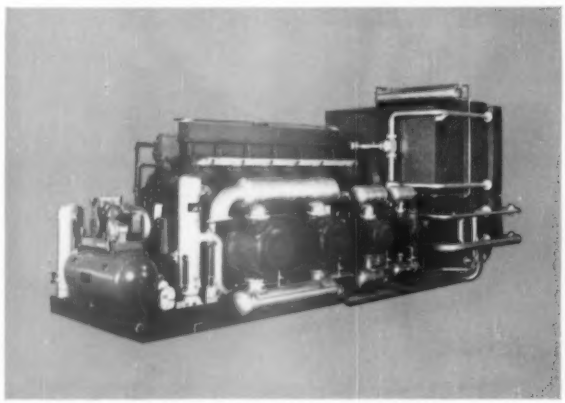
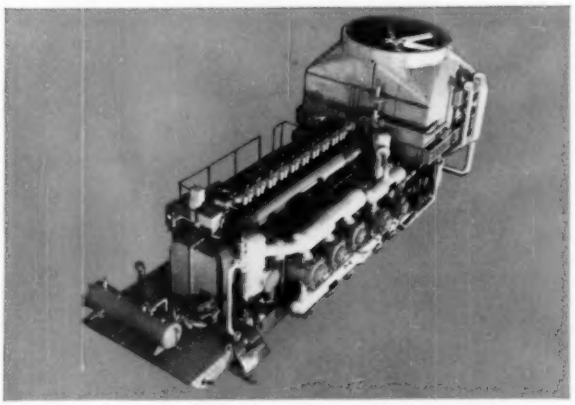
DESIGNS, ENGINEERS, BUILDS AND INSTALLS PACKAGED COMPRESSOR PLANTS

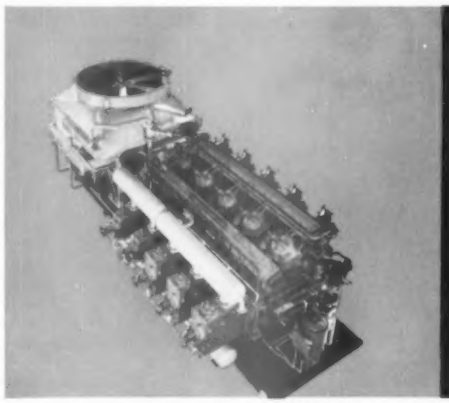
Using the Compressor You Select



A 660 hp Ingersoll-Rand 12-SVG-2 compressor packaged by Southwest Industries, is in gas injection service in West Texas.



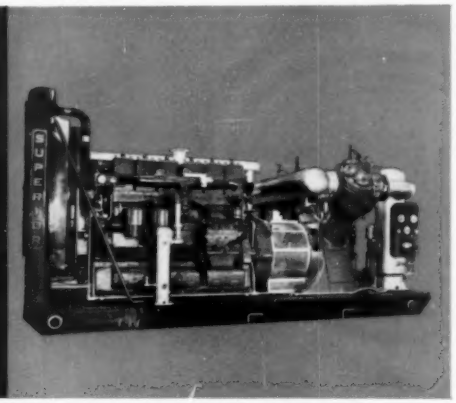
A Clark HMAB-10 compressor packaged by Southwest for a major oil company is in service for gas sales boosting in South Louisiana.



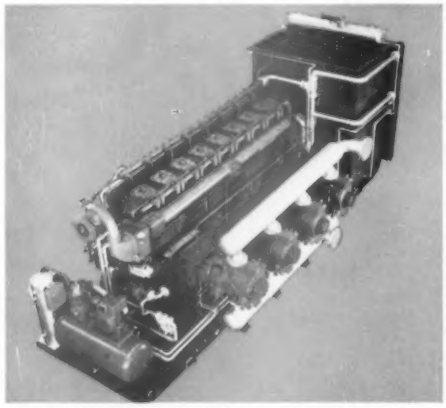
This 660 hp Cooper-Bessemer GMXD-10 compressor has been packaged by Southwest for gas gathering service on an offshore platform in South Louisiana.

SOUTHWEST INDUSTRIES, INC.

P. O. Box 19188, Houston 24, Texas



This 200 hp unit utilizing a Joy WB-12 compressor direct driven by a Superior 6G-510 Engine at 600 rpm was packaged by Southwest for propane service in a major oil company's gasoline plant.

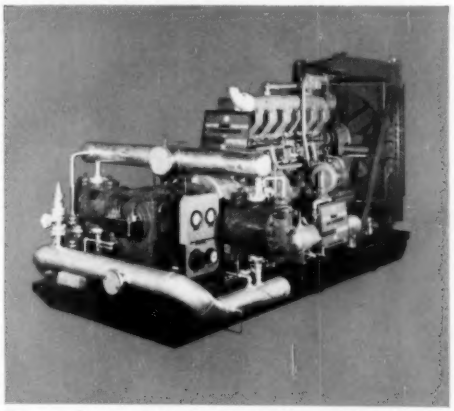


This 750 hp Worthington SLHC-8 compressor in a Southwest Packaged Plant is being used by a major gas transmission company for pipeline boosting in East Texas.

PLANTS:
Houston, Texas
Calgary, Alberta, Canada
Mexico, D.F., Mexico

BRANCH OFFICES:
Tulsa, Oklahoma
New Orleans, Louisiana
Calgary, Alberta, Canada
Mexico, D.F., Mexico

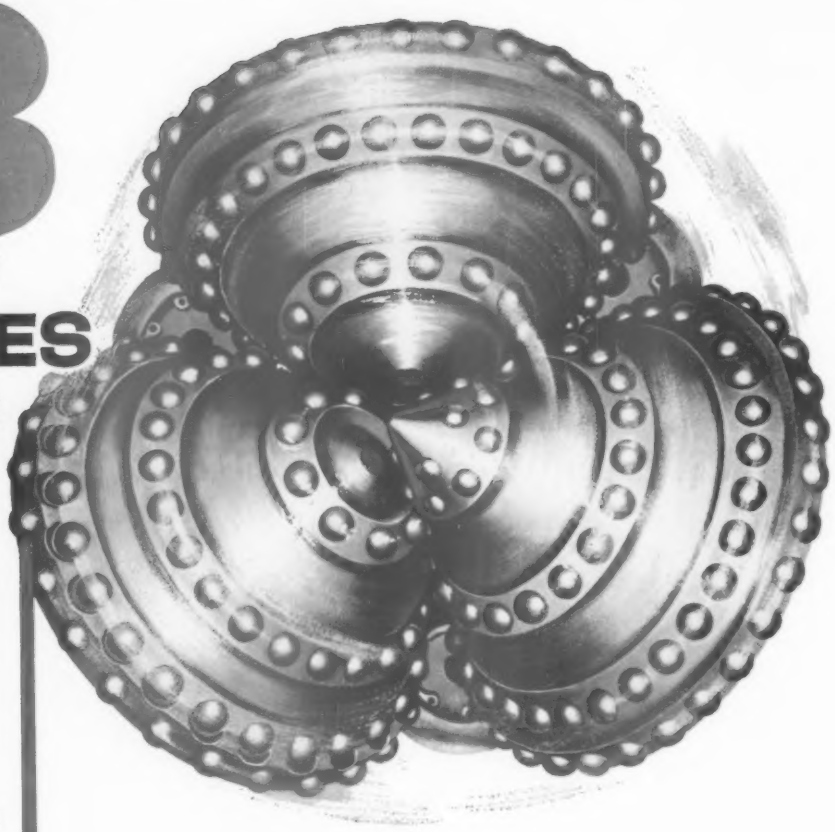
SALES AGENCIES:
New York, New York
Detroit, Michigan
Chicago, Illinois
Los Angeles, California
Equipex, S.A., Caracas, Venezuela

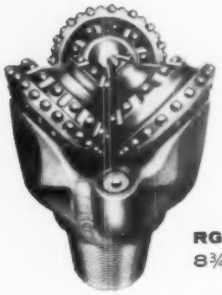


For a major gas transmission company, Southwest packaged this Ingersoll-Rand HHE-2 compressor with direct connection to a Waukesha LRORB Engine, operating at 1000 rpm and developing 250 hp.

Also designers and manufacturers of Packaged Natural Gasoline Plants, Packaged Inert Gas Generators, Packaged CO_2 and H_2S Removal Units.

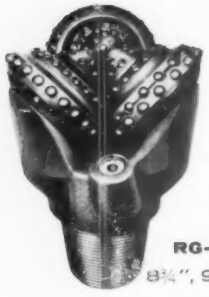
3 New HUGHES bits





RG-7J
8¾"

RG-1J
6" – 9"



RG-2BJ
8¾", 9", 9⅞"

...cut hole time in hardest digging

Footage and penetration rate are being substantially increased with the three new Hugheset bits, pictured here. They are expanding the range of formations that can be advantageously drilled by R Series bits. The three new Hugheset bits have been designed to drill specific segments of hard formations. All three are fortified on the gage surfaces with sintered tungsten carbide compacts to minimize wear and assure full gage hole.

1. RG-7J is designed to drill the weaker or softer segment of hard formations (lime, dolomite and hard sandy shale). Design of the bit assures more action on bottom and faster penetration. Deeper intermesh, wide spacing of the compacts, and interruptions of the lands make it possible for the RG-7J to more economically drill formations previously drilled by hard formation milled-cutter bits and R-1 bits.

2. RG-1J, which replaces the R-1, R-1J and RG-1, is designed to drill the medium range of hard formations which normally are very abrasive. Because of its fortified gage, RG-1J performance in these formations is outstanding.

3. RG-2BJ – identified by spearpoints on each of the three cones – has larger diameter compacts and a maximum number of compacts on all rows and on the gage surfaces. It is the most rugged of the R Series bits. It is designed to drill the hardest of hard abrasive formations, such as quartzite and hard quartzitic sands.

HUGHES TOOL COMPANY

ORIGINATOR AND WORLD'S LEADING DEVELOPER OF CONE-TYPE ROCK BITS